FISH USE OF INSHORE HABITATS NORTH OF THE ALASKA PENINSULA

JUNE - SEPTEMBER 1984 and JUNE - JULY 1985

by

John S. Isakson and Jonathan P. Houghton
Dames & Moore
155 N.E. 100th Street, Suite 500
Seattle, Washington 98125

Donald E. Rogers and Steven S. Parker
Fisheries Research Institute
University of Washington
Seattle, Washington 98195

Final Report
Outer Continental Shelf Environmental Assessment Program
Research Unit 659

November 1986

TABLE OF CONTENTS

TABLE OF CONTENTS (Continued)

TABLE OF CONTENTS (Continued)

LIST OF FIGURES

LIST OF FIGURES (Continued)

Figure

LIST OF FIGURES (Continued)

LIST OF FIGURES (Continued)

Figure

LIST OF TABLES

Table

Table

ACKNOWLEDGEMENTS

This study was funded (wholly or in part, whichever is appropriate) by the Minerals Management Service, Department of the Interior through an Interagency Agreement with the National Oceanic and Atmospheric Administration, Department of Commerce, as part of the Alaska Outer Continental Shelf Environmental Assessment Program. This program could not have been completed without the commitment and energy of the three major organizations involved: NOAA, Dames & Moore, and the University of Washington, Fisheries Research Institute (FRI). Participants in the field program who endured small boat life under difficult circumstances included: Greg Blair, Greg Erickson, Peter Hagen, Jeff Haymes, Russell Ladley, Kevin Latorra, Jeff Moore, Pat Poe, Greg Polkinghorn, Torn Rogers, and Greg Ruggerone. Added field assistance came from Robert D. Paulus, skipper of the R. V. Kittiwake, whose past fisheries experience and local knowledge allowed much of the field program to succeed.

External to the study team but of major importance to the field success was the support of Peter pan Seafoods at Naknek and Port Moller. Don Rawlinson and Dexter Lall, who manage the Naknek and Port Moller operations, respectively, proved very helpful. Ray Earl, Port Moller Beach Boss in 1984, was also extremely helpful during several boat mechanical failures.

On the analytical side, William Driskell, consultant to Dames & Moore, and Mike McDowell of Dames & Moore deserve special credit for designing data forms, data entry programs, and manipulating catch data. Stephen Jewett and Michael Dell each contributed reviews and analyses of historic data.

Finally, the free use of FRI gear (whaler, outboards, etc.) and field stations (Wood River, Chignik) between cruises in 1984 allowed the work to be completed at a reduced cost.

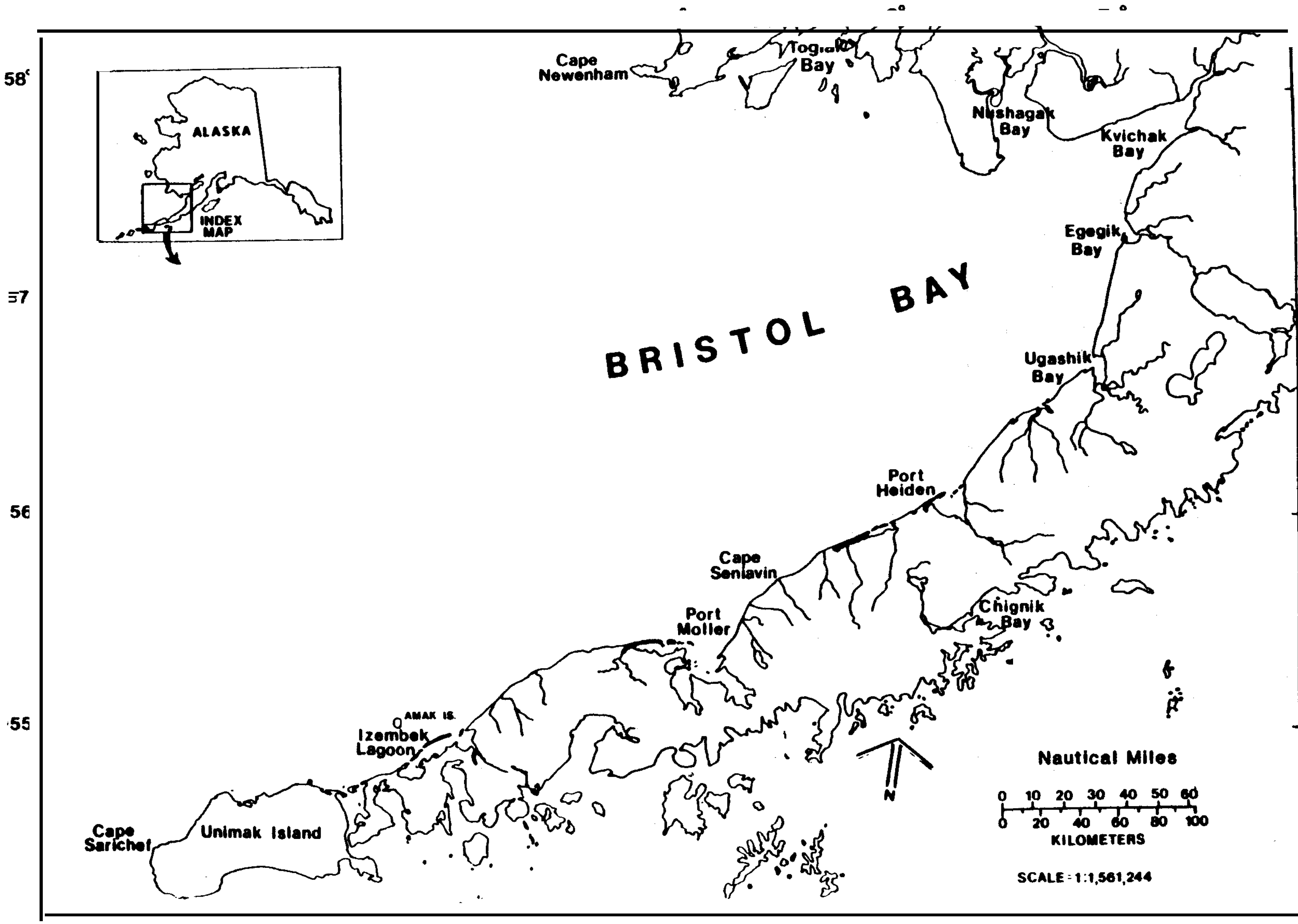
1.0 EXECUTIVE SUMMARY

1.1 OBJECTIVES

The Bering Sea as a whole produces a substantial fraction of the world's annual harvest of seafoods, with major fisheries for salmon, large shellfish, and groundfish. Anticipation of upcoming oil and gas lease sales in the eastern Bering Sea Basin established a need for a greater understanding of the interrelationship of various components of the marine ecosystem of the Bering Sea. Over the past several years, the National Oceanic and Atmospheric Administration (NOAA) Outer Continental Shelf Environmental Assessment Program (OCSEAP) has sponsored studies of many of these Bering Sea ecosystem components in an effort to provide the data necessary to permit informed decision making in the region. Recent syntheses of this data base identified a major information need for understanding of the importance of the nearshore zone and embayments along the north side of the Alaska Peninsula for fish, especially for the many millions of juvenile salmon migrating from area rivers each spring.

This research (Research Unit 659) was designed to provide the baseline descriptions of fish assemblages needed to assess potential and actual impacts of oil and gas development on natural resources of the study area (Figure 1). Primary objectives were to:

- Describe the species composition of demersal and pelagic fish assemblages in poorly-studied nearshore, intertidal, and estuarine habitats of the study area.
- Determine relative abundances of species by habitat, area, and season (spring, summer, and fall).
- Describe changes in distributions of adults and juveniles occurring over time scales of tide cycles to seasons, including inshore-offshore migrations and directed migrations through the study area.



Study Area

Dames & Moore

Figure 1

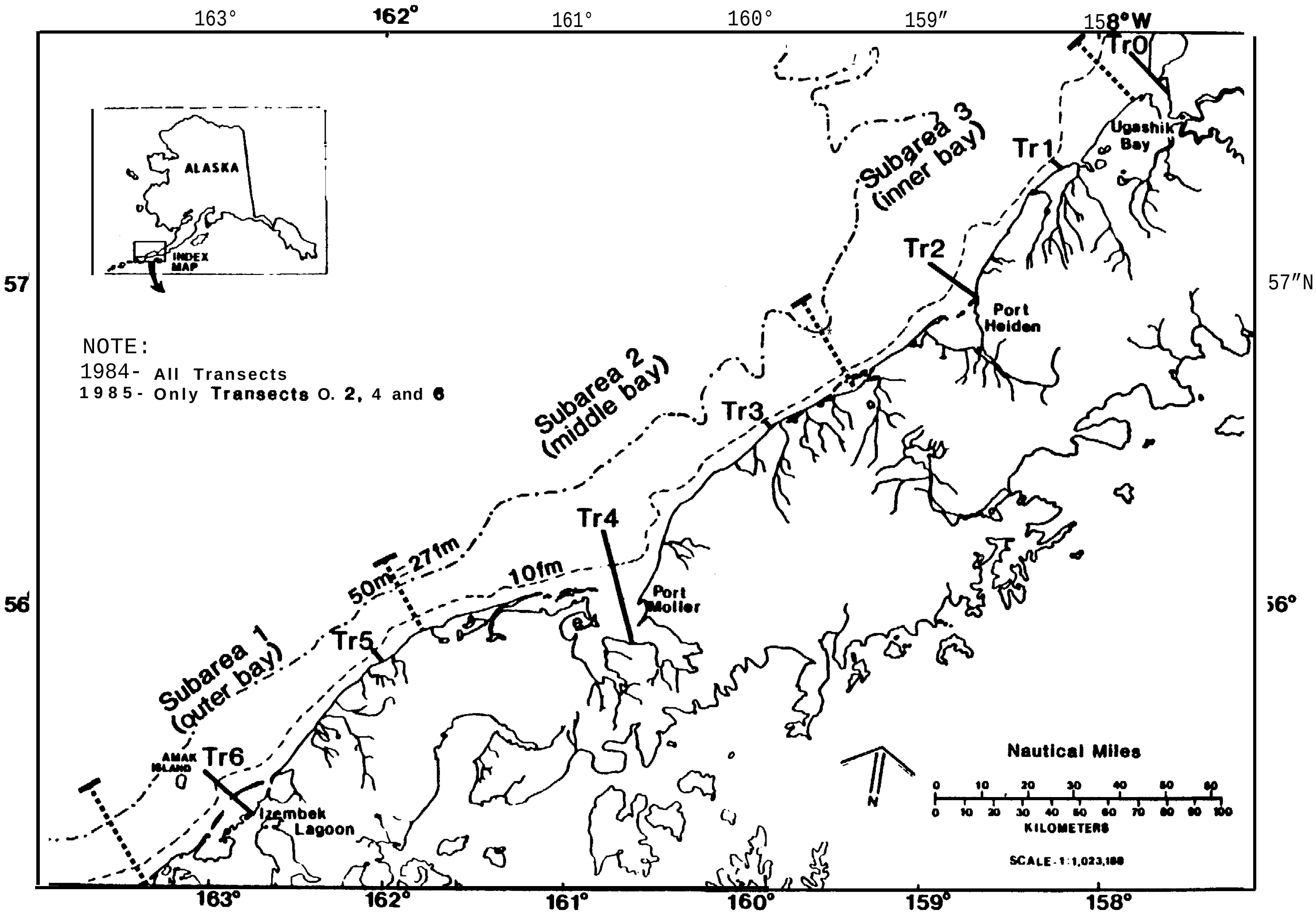
Assessments of potential impacts on salmon and other pelagic and demersal finfish of OCS oil and gas exploration and development on the North Aleutian shelf and basin have been made by NOAA (Thorsteinson 1984), MMS (1985), and Bax (1985). In the case of juvenile salmonids, these assessments were based primarily on syntheses and broad generalizations of distribution and movement patterns from data collected in the late 1960s and early 1970s (generally at 20 m or greater depths), and variously reported by Straty (1974, 1975, 1981) and Straty and Jaenike (1980). A major goal of the study reported here was to provide information to confirm or deny the validity of many of these generalizations for waters closer to the shoreline.

This 2-year study was conducted by Dames & Moore in association with Fisheries Research Institute (FRI), University of Washington, and was performed under NOAA Contract 84-ABC-00122.

1.2 GENERAL APPROACH

The general approach of this study was to carefully allocate the limited resources of sampling effort and time in order to maximize the collection of new information on the movement and abundance of commercially significant finfish in inshore habitats (e.g., within 50-m isobath) that are considered to be most vulnerable to perturbation from OCS development.

In 1984, our study area extended from False Pass to Ugashik Bay in waters to about 30 m deep (Figure 2). It encompassed two estuaries (Port Heiden and Port Moller) and a coastal lagoon (Izembek Lagoon), as well as exposed coastal and inshore habitats. The estuarine systems are representative of those in inner Bristol Bay. Izembek Lagoon deserves special attention due to its highly productive character. Sampling was also conducted in Ugashik Bay as a matter of opportunity (while seeking refuge from unworkable weather conditions outside the Bay). Sampling was focused at depth-stratified stations on six transects spaced throughout the study area to include three with associated embayments and three from exposed beaches (Figure 2). Depending on station characteristics, each was sampled by one or more of the following gear types:



Study Subareas and Transect Locations

Figure

Dames & Moore

purse seine or tow net (targeting pelagic species): otter trawl and beam trawl (targeting demersal fish); beach seine (targeting littoral fish assemblages).

In 1985, our study area covered the same area along the Alaska Peninsula as in 1984, except that Ugashik (Transect O) was added as a formal transect and a new outside station (numbered O) was added at all transects to extend sampling to 15 nautical miles offshore. Only Transects O, 2, 4, and 6 were sampled (the so-called “bay transects”); Transects 1, 3, and 5 (the “open-coast transects”) were dropped to allow greater sampling replication at remaining transects (Figure 2). An additional offshore sampling difference was that the three stations farthest offshore (numbered O, 1, and 2) were stratified by distance offshore at 24, 16, and “8 km (15, 10, and 5 nautical miles) in 1985, versus the depth stratification approach of 1984. Due to this distance stratification in 1985, sampling depths at the outside station (numbered O) ranged from 30 to over 50 m. For the most part, nearshore or bay sampling stations in 1985 remained the same as in 1984. In contrast to the 1984 sampling with 5 gear types, 3 gear types (otter trawl, beam trawl, and tow net) were dropped in 1985 and a new gear type added (small purse seine). Thus, only the beach seine, purse seine, and small purse seine’were used in 1985. The gear-type selection in 1985 was made to place more emphasis on pelagic species, especially juvenile salmon.

Three sampling cruises were undertaken in 1984 (late June to mid-July, late July to mid-August, late August to mid–September). In 1985, one 6-week cruise occurred from mid-June to the end of July. Sampling was conducted using a 55-foot, a 29-foot, and two smaller vessels. A total of 277 sets of all gear types was made in 1984, while 172 sets were made in 1985.

All fish captured were either processed on board or preserved for later analysis.

1.3 RESULTS AND CONCLUSIONS

Weather and surface sea temperatures were strikingly different between 1984 and 1985. For the three cruises in 1984, generally poor to harsh weather was experienced, while for the single extended cruise in 1985, much calmer weather was generally present in the study area. Sea surface temperatures for similar areas and times of year were from 1 to 2°C colder in 1985 than in 1984. Salinities for comparable areas and times were quite similar between these two years.

The main difference in 1984 and 1985 results was the change in catch ratios of demersal to pelagic fish assemblages due to dropping the otter and beam trawls and starting earlier in the 1985 effort. While juvenile salmonids made up less than 1 percent of all fish caught in 1984, these fish made up 52 percent of the total catch in 1985. Over 88,400 fish were caught by 277 sets of all five gear types deployed in 1984. In 1985, almost 30,000 fish were caught by 172 sets of the three gear types deployed. These catches represented 54 taxa, including all five species of Pacific salmon common in the eastern Pacific.

1.3.1 Salmonids

1984 - Cruises 1, 2, and 3

Despite the fact that over half of our 1984 sampling effort (158 of 277 sets; Table la) was with gear types selected to catch juvenile salmon, this group represented only about 1 percent of all fish captured. For example, our average catch of juvenile salmonids in purse seines was only 8.21 per set (standardized to 10 minutes). Catches were very patchy and the conclusions stated below regarding catch patterns are correspondingly weak. Cruise 1 (late June to mid-July) purse seine catch of salmonids (8.60 per set) was dominated numerically by coho juveniles (78 percent; primarily because of one large catch on Transect 2) off port Heiden, followed by sockeye (23 percent), and chums (<1 percent). Cruise 2 (late July to mid-August) purse seine catch (9.86 per set) was dominated by sockeye (54 percent) and chum salmon (34 percent). Catch rate was up markedly for both species. Juvenile coho (7

TAELE la

TOTAL CATCH SUMMARY - 1 984[a]

Species Name	RAW CATCH BY SPECIES					
	Purse Seine	Beach Seine	20x9 Towne t	Otter Trawl	Seam Trawl	Total All Gear
Alaska Plaice	1	54(8)		460(6)	5	520 (9)
Arctic cod	1			1		2
Arctic Flounder		7	3			10
Arctic Lamprey	9		4			13
Bering Poacher	2	19		357(7)	2	3s0
Brightbelly Sculpin				5		5
Butter Sole				20		20
Capelin		1				1
Chinook Salmon Juv.	21	2	3			26
Chum Adult	30	17				47
Chum Salmon Juv.	288(6)	22	32(4)			342
Coho Adult		1				.1
Coho Salmon Juv.	195(8)	27				222
Crescent Gunnel	7			12	1	20
Crested Sculpin	10	1	1	1		13
Dolly Varden Adult	2	4				6
Eu lachon		13		9		22
Flathead Sole			1	4		5
Great Sculpin		1		1		2
Kelp Greenling		1		6		7
Liparis SP			1	5		6
Longhead Dab		2		164	1	167
Ninespine Sticklebacks	19	3	24(6)			46
Pacific Cod	3007 (1)	83(6)	4	3666(2)	1	6761(4)
Pacific Halibut		1		64	1	66
Pacific Herring	4	3	742(3)	1		750' 7)
Pacific Sandfish	292(5)	5	28(5)	44		369
Pacific Sand Lance	1102(2)	33177(1)	20043(1)	954(4)		55277' 11
Padded Sculpin				3		3
Pink Adult	6					6
Pink Salmon Juv.	5					5
Plain Sculpin		4	1	2		7
Pleuronectidae	2		1			3
Pond Smelt		27				27
Rainbow Smelt	34	940(2)	7020(2)	285(10)	5	8292(3)
Ribbed Sculpin				11		11
Rock Sole	5	29		1487(3)	26(3)	1547(6)
Sailfin Sculpin				2		2
Sculpin D		3		5		8
Silverspotted Sculpin	6			2		8
Snake Prickleback	3	4	5(9)	356(8)	40(2)	408(10)
Sockeye Adult	87(10)	1				88
Sockeye Salmon Juv.	262(7)	33(10)	8			303
Staghorn Sculpin		159(4)		40		199
Starry Flounder	5	106(5)	15(8)	77		205
Sturgeon Poacher	1	1		39		41
Surf Smelt	1	216(3)		1		218
Threaded Sculpin		7		318(9)		332
Thraespine Sticklebacks	3	4				7
Tidepool Sculpin				1		1
Tubanose Poacher		14	1	174		192
Unid. Cods	163(9)					163
Unid. Smelt	31	14	15(8)	2		62
Walleye Pollock	557(4)			31		588 B)
Whitespotted Greenling	1090(3)	35(9)	7(10)	615(5)	3	1750(5)
Wolf-eel	6					6
Yellowfin Sole	19	74(7)	20(7)	8657(1)	79(1)	8849(2)
Totals	7276	35122	27979	17882	177	88436
All Juvenile Salmonids	771	84	43			898
Number of Hauls	71	47	40	117	2	277

[a] Numbers in parentheses ( ) repreeent ranking of catches.

TABLE lb

TOTAL CATCH SUMMARY - 1985[a]

Common Species Name	RAW CA TCHBY SPECIES Small Seine	Purse Seine	Beach Seine	Total All Gear
Alaska Plaice			52	52
Arctic Flounder			94	94
Arctic Lamprey	2	7		9
Cape 1 in	3	106		109
Chinook Salmon Juv.	2	2	2	6
Chum Salmon Adult		23	2	25
Chum Salmon Juv.	758(2)	403(3)	3970(2)	5131(3)
Cod Unid.			4	4
Coho Salmon Juv.	52	178(5)	61	291(8)
Dolly Varden Adult		7	2	9
Dolly Varden Juv.		40		40
Great Sculpin		1	3	4
Greenling Unid.		1		1
Ninespine Sticklebacks			2	2
Pacific Cod		10	2	12
Pacific Herring	15	27	13	55
Pacific Sandfish	1	81		82
Pacific Sandlance	336(4)	1006(2)	8308(1)	9650(1)
Pink Salmon Adult		4		4
Pink Salmon Juv.	115(5)	5	832(4)	952 5)
Pond Smelt			96	96
Rainbow Smelt	700(3)	13	2033(3)	2746 4)
Rock Sole			13	13
Saddleback Gunnel			3	3
Sculpin Unid.			1	1
Smelt Unid.		6		6
Snake Prickleback	1		77	78
Sockeye Salmon Adult		386(4)		386(7)
Sockeye Salmon Juv.	738(1)	8498(1)	5	9241(2)
Staghorn Sculpin	2	1	49	52
Starry Flounder		6	610(5)	616(6)
Sturgeon Poacher		1	3	4
Threaded Sculpin			1	1
Threespine Sticklebacks	2	33	3	38
Tubenose Poacher				0
Walleye Pollock		15	2	17
Whitespotted Greenling	4	121	3	128(9)
Yellowfin Sole		7	20	27
Totals	2732	10988	16266	29986

[a] Numbers in parentheses ( ) represent ranking of catches.

percent) and chinook (4.6 percent) were also common during Cruise 2. Pink salmon juveniles were only taken in Cruise 2, Transect 4 (Port Moller), Station 1. Purse seine catch rate (5.82 per set) in the third cruise was substantially lower than in the second, despite one very large catch (Transect 1). Chum salmon juveniles dominated this single large catch and, hence, dominated the total catch numerically (94 percent of all juvenile salmon). Sockeye followed (6.9 percent) with the remainder comprised of coho and chinook juveniles.

Stations 1 and 3 (27 m, 11 m) had a higher overall purse seine catch rate for juvenile salmonids (all species, cruises, and transects combined) than did the intermediate Station 2 (20 m), primarily because no single large catch was made in any of the sets at Station 2. During Cruise 2, when the most complete purse seining coverage was achieved (3 stations on each of 5 transects sampled), there was a steady increase in the numbers of juvenile salmon with distance offshore. Geographically, the overall purse seine catch rate (all species and stations combined) was greatest during Cruises 1 and 3 at the inner Bristol Bay transects (1 and 2), declining at middle-bay transects (3 and 4), and declining further at the outer transects (5 and 6). During Cruise 2, strong catches of chums and sockeye on Transect 3 altered this picture somewhat; however, catch rates on Transects 1 and 3 greatly exceeded those on Transects 4 through 6. Length-frequency evaluations made for the small sample of juvenile sockeye and chum salmon taken in 1984 showed reasonable patterns of growth and movement through the study area.

Our low catch rate for juvenile salmonids in 1984 (compared to that of earlier studies) was attributed to smaller seine size and to our late start which likely missed peak sockeye migrations. It was also thought that our catch rates (e.g., Cruise 2 purse seine results) might reflect less preference for shoreline areas (which are extremely dynamic in the Bering Sea) than is the case for other areas.

1985 - Cruises 4a and 4b

Systematic coverage of the study area from mid-June through July 1985 revealed that large numbers of juvenile salmonids seasonally occupy the nearshore waters of the North Aleutian Shelf (NAS). A total of 15,619 juvenile salmonids was captured in 97 large purse seine sets, 34 small seine sets, and 41 beach seine sets (Table lb, p. 22) . Approximately 59 percent of all salmonids were sockeye, 33 percent were chum, 6 percent were pink, 2 percent were coho, and < 0.1 percent were chinook.

Strong trends in relative abundance were apparent in the sockeye catch data. High mean large purse seine CPUE (88.5 fish/set) compared to those for small seine (22.4) and beach seine (0.1) describe a coastal distribution for sockeye with relatively little use of littoral habitats. Purse seine CPUE declined with distance down the Alaska Peninsula, distance offshore, and time. Comparatively larger catches of sockeye juveniles at inner bay transects (Ugashik and Port Heiden) suggested a narrow migration corridor less than about 15 nautical miles (rim) wide, whereas smaller catches at outer bay transects indicated that the migration band either dispersed or was displaced offshore between Port Heiden and Izembek Lagoon.

Small numbers of juvenile coho salmon were taken routinely, but not consistently, at all locations in 1985. Mean CPUE for the survey (all gear combined) was 1.7 fish per set. Abundance generally increased over time and with distance out of Bristol Bay. Coho were rare or absent in beach seine and small seine catches at Ugashik and Port Heiden at all times, but were common in all gear and at all times at Port Moller. The consistency of catches at all times and in all habitats suggests that Port Moller is an important secondary rearing area for juvenile coho salmon.

Juvenile chum salmon were present only in intertidal habitats inside Port Moller during the first half of the 1985 survey period (Cruise 4a; June 16 to July 7), but became relatively abundant throughout the study area in the second half (Cruise 4b; July 8 to 28). Mean CPUE for chums was 30.5 fish per set (all gear combined), although much of this was due to a single beach seine catch of nearly 3,300 fish. A shift from intertidal to subtidal and offshore habitats was evident from changes in CPUE of each gear type over time. The pattern of habitat utilization in Port Moller clearly shows this estuary to be an important nursery area for local chum salmon stocks.

Pink salmon were not widely distributed in the study area in 1985. Mean CPUE for this species was 5.7 fish per set (all gear combined). Juvenile pink salmon were taken only at port Moller, with the exception of two migrants captured in purse seine sets at Ugashik on the last days of the survey. The low incidence of migrating juvenile pink salmon in purse seine catches probably was due to the termination of sampling early in summer before Bristol Bay pinks had arrived in the study area.

Only six juvenile chinook were taken by all gear during the 1985 survey. Four of the six were taken near Ugashik Bay, which is known to support a run of adults. It is possible that juvenile chinook migrated out of the study area earlier, perhaps at depths inaccessible to the purse seine, so that small catches do not accurately reflect the relative abundance of this species in the NAS study area.

Sockeye Salmon Scale Pattern Analysis

Statistical evaluation of differences in fish growth by analysis of scale patterns is frequently used to distinguish individual stocks comprising mixed-stock samples. Previous stock identification studies suggested that the growth patterns in scales of Bristol Bay sockeye salmon were measurably different between stocks. Resulting estimates of stock mixing proportions could provide additional information on migration rates and routes of particular sockeye stocks in the eastern Bering Sea. We conducted a similar study to identify the rivers of origin of juvenile sockeye in purse seine catches at the Ugashik and Port Heiden transects.

A linear discriminant function (LDF) analysis of scale measurement data revealed that differences in scale growth patterns were not as distinct in 1985 as had been expected. Known samples of the scale patterns specific to each of the five major Bristol Bay stocks were assembled from scales collected in each system during the period of smelt outmigration in 1985. Statistical comparisons of scale patterns within and between these "training" samples established the accuracy of the LDF in assigning stock membership to the scales of unknown origin (captured in this survey at Ugashik and Port Heiden). Unfortunately, Ugashik, Naknek, and Wood River scales were virtually indistinguishable. It is noteworthy that the size of Wood River smelts in 1985 was the second largest since 1954, which undoubtedly masked the expected distinction between this stock and the others. Resultant classification accuracies achieved were 60.3 percent for a Wood River-excluded LDF and 64.3 percent for a Ugashik-excluded LDF. (These exclusions were made based on known migration timing characteristics.)

In view of the poor separability of scale patterns in 1985, stock classification of the 318 scales of unknown origin was not very meaningful. The LDF analysis suggested that catches in all time periods, from June 19 and 20 to July 27 and 28, were predominantly Naknek sockeye. Although stock composition estimates were not completely unrealistic, their poor reliability precluded any conclusive statements regarding stock composition of catches at Ugashik and Port Heiden.

Adult Salmonids

Adult salmon were not specifically targeted in this survey because their numbers and distributions in the NAS study area are documented by commercial catch and escapement records maintained by the Alaska Department of Fish and Game (ADF&G). These records showed that nearly 4.6 million salmon were caught or escaped to spawning grounds within the boundaries of our study area in 1985. Sockeye were most abundant (3.4 million), followed by chum (0.9 million), coho (0.3 million), chinook (37,000) and pink (4,900). Port Moller and Bear River areas formed the center of salmon abundance. Adult sockeye captured off Ugashik Bay were found to be aggressively feeding on euphausiids on June 20 and on July 12, 1985. Evidence of feeding within the influence of freshwater was unexpected, although the ultimate destination of feeding fish could not be determined.

Discussion of 1984 and 1985 Results

It is more appropriate to view the results of 1984 sampling as an extension of 1985 activities rather than to compare results across years. Virtually all of Cruise 4 (1985) was completed in water temperatures lower than those recorded at the beginning of Cruise 1 in 1984. The relative climatological (and, presumably, biological) timing of 1984 and 1985 sampling periods was almost without overlap. Therefore, the results of the 1985 survey should be viewed as representative of conditions that may have existed in 1984 before our sampling activity began. Similarly, the 1984 results may be representative of conditions that may have existed in 1985 after the termination of sampling activity.

The 1985 results disproved one of our originally proposed (Houghton et al. 1985) explanations for low salmonid CPUE in 1984 and confirms another. As a result of consistently small catches of juvenile salmonids in 1984, it was suggested that either the survey had missed peak abundances of juvenile sockeye in the study area, or that nearshore and estuarine habitats in the NAS study area were not heavily utilized by juvenile salmonids. Since sampling began much earlier in 1985 relative to peak migratory activity of juvenile sockeye salmon, it was confirmed that peak abundances of sockeye undoubtedly had occurred in the study area in 1984 prior to start-up of survey activities. Further, comparatively large catches of salmonids in 1985 demonstrate that nearshore and estuarine waters are very important rearing and migration habitats for juvenile salmonids, especially sockeye and chum salmon.

The model of sockeye salmon migration proposed by Straty (1974) is largely supported by the present results, to the extent that the surveys overlap. The intensive inshore coverage in the present study complements the extensive offshore sampling of the earlier survey. Major trends in the migration patterns of juvenile sockeye in 1984-1985 were nearly identical in many cases to those documented by Straty – for example, the strong shoreward bias of catches off Port Heiden.

We would amend the Straty model only to point out, as noted above, that interannual variation in the factors influencing the time/space pattern of migration can be quite pronounced; thus, they may substantially modify details of the general migration patterns concluded from that survey.

As for the other species of salmon, new data accumulated in course of R.U. 659 indicate that coastal embayments in the NAS study zone are highly important for juvenile chum, pink, and coho salmon. Data for chinook salmon are inconclusive on this point, but we know that locally important runs of adults return to both the Nushagak and Ugashik systems. Port Moller supports impressive numbers of juvenile salmon, especially pinks and chums, and appears to be more important in this respect than other embayments along the north side of the peninsula.

1.3.2 Nonsalmonids

1984 - Cruises 1, 2, and 3

Of the 88,436 fish captured in the 1984 sampling, 99 percent, representing 47 taxa, were nonsalmonids (Table la). By far the most dominant species was Pacific sand lance, which comprised 62.5 percent of all fish captured. Sand lance were the most abundant species in both the beach seine and tow net and ranked second (to Pacific cod) in purse seines and fourth in otter trawls. These results seem to confirm this species' role as one of, if not the most, important forage fish in this part of the Bering Sea. Densities appeared greater in the inshore waters (inside the 6-m isobath fished by the beach seine and tow net) during the first two cruises. Sand lance were widely yet irregularly distributed throughout the study area with significant concentrations encountered in beach seines in and outside of Port Moller during the first cruise (late June to mid-July), and in otter trawls in Izembek Lagoon during the third cruise (late August to mid-September). (Izembek Lagoon was not sampled in the first cruise.)

The second most abundant pelagic species in our 1984 catches was the rainbow smelt, which comprised 9.4 percent of the total catch (ranked second in both the beach seines and tow nets). Like the sand lance, rainbow smelt were most abundant in nearshore gear.

The third most abundant fish taken in the pelagic habitat in 1984 was Pacific cod, which ranked first in purse seine and second in otter trawl catches. This distribution demonstrates the preference of juvenile cod for offshore pelagic as well as demersal habitats. Catches in the second and third cruises greatly exceeded those in the first cruise, partially, at least, due to recruitment to the gear. Whitespotted greenling (third in purse seine), Pacific herring (third in the tow net), and walleye pollock (fourth in the purse seine) rounded out the most abundant nonsalmonids encountered in the pelagic habitat.

Otter trawl catches (mean fish weight per trawl) displayed no clear north-south trends, with Transects 1 and 6 having the highest values (all species and offshore stations combined). Of the offshore stations (at 6, 11, and 20 m) the n-m station had the highest catch per unit effort (CPUE) on the three northern transects and the Izembek transect but was relatively lower on the remaining two transects. Stations inside Port Moller had much higher otter trawl catches than those outside, while the opposite was true for the Izembek transect.

Demersal fish communities sampled by otter trawl were dominated in order by yellowfin sole, Pacific cod, rock sole, Pacific sand lance, whitespotted greenling, and Alaska plaice. Yellowfin sole were widely distributed in the study area. The only apparent trend was for lower catches (numbers) in Izembek Lagoon compared to Port Moller. There was also a steady overall decline in catch through the sampling period. Rock sole likewise showed little geographic pattern but had a generally declining capture rate (numbers) over the sampling period.

Length-frequency evaluations were completed for the most important species and contributed to our overall understanding of the patterns of use of these areas by nonsalmonids.

<u>1985 - Cruises 4a and 4b</u>

Since otter trawling was not conducted in 1985, all but the incidental catch of demersal fish was eliminated. The 1985 sampling of nonsalmonids focused on pelagic fish assemblages that could be taken with the large or small purse seines and the littoral fish assemblages taken in both years with beach seines.

Of the 25 nonsalmonid species taken in 1985, only 6 species are considered pelagic. Despite this, pelagic fish species dominated the 1985 sampling effort. Pacific sand lance and rainbow smelt made up 41 percent of the total number of fish taken in 1985. While their numbers appeared to be fewer than in 1984, Pacific sand lance again were shown to be a very important forage fish in the study area. As in 1984, rainbow smelt was the second ranked nonsalmonid.

2.0 INTRODUCTION

2.1 PROJECT BACKGROUND AND OBJECTIVES

Anticipation of oil and gas lease sales in the North Aleutian Shelf (NAS), St. George Basin, and to a lesser extent the Navarin Basin, established a need for a greater understanding of the interrelationship of various components of the marine ecosystem of the Bering Sea. The Bering Sea as a whole produces a substantial fraction of the world's annual harvest of seafoods, with major fisheries for salmon, large shellfish (king and tanner crab), and groundfish (halibut, pollock, and cod). Lesser harvests of forage species (herring) and marine mammals (fur seals) also occur. Shellfish and finfish resources in the southeastern Bering Sea and Bristol Bay support a substantial proportion of these commercial fisheries. Domestic harvests of salmon, crab, demersal fish, and groundfish stocks are valued at over $1 billion annually, with salmon and crab catches together accounting for over $400 million in recent years. In potential conflict with these living renewable resources is the need to explore and possibly develop deposits of petroleum and gas suspected to underlie the St. George Basin and the NAS.

The area of interest in this study, Bristol Bay from Cape Sarichef to Cape Newenham inside the 30- to 50-m isobath (Figure 1), is thought to be an integral part of the Bering Sea ecosystem as a whole; it supports concentrated use at various times of the year by a wide variety of organisms, including many that are of extreme commercial, ecological, and political importance. Because of the immense resource and ecological value of the area, there is a very high level of concern among the fishing industry, regional natives, conservation community, and the general public regarding the potential impacts of oil and gas development in the region.

OCSEAP has recognized the potential for conflict and the need for additional information upon which to base management decisions. A variety of research programs has been funded in the southern Bering Sea since 1975, culminating in the North Aleutian Shelf Synthesis Report

(Thorsteinson 1984) and the Environmental Characterization of the North Aleutian Shelf Nearshore Region (Kinnetic Laboratories, Inc. 1984). This latter document attempted to summarize all available information on the area and to describe the ecological processes which might support the observed biological distributions and productivities. -This report also sought to develop an endemic trophic system model for the North Aleutian Peninsula nearshore zone and to identify research and assessment information needs. Kinnetic Laboratories, Inc. (1984) concluded that significant data needs remain. One of these needs was in the general understanding of the importance of the nearshore zone to important marine fishes (especially juvenile anadromous salmonids) and the vulnerabilities of these resources to potential OCS development impacts. Bax (1985) provided an assessment of some of these potential impacts on salmonids using the historical data of Straty (1974) and Hartt and Dell (1978).

Participants at the NOAA/MMS-sponsored NAS Synthesis Meeting (Thorsteinson 1984) were asked to evaluate the status of information on the distribution and abundance of commercially valuable fish resources in relation to oil and gas development in the proposed lease area. Particular attention was given to potential impacts on Pacific salmon, since both juveniles and adults of this valuable resource are known to seasonally occupy areas of the NAS expected to be most severely impacted by OCS development. However, larval and adult forms of other commercially significant finfish species also feed, mature, and reproduce in the nearshore marine waters of the NAS. The life functions of these species normally are limited in the time or space in which they may be performed successfully (e.g., reproduction usually is constrained to specific habitats and seasons, and young fish may require specialized nursery areas). These constraints on time and space are thought to influence in large part the mortality rate of larval forms of many fish species. It is assumed that a major risk in petroleum development is the potential introduction of a pollutant that may accentuate these natural constraints. Proceedings of the workshop (Thorsteinson 1984) confirmed that there were major information needs regarding seasonal abundance of pelagic and demersal fish in nearshore areas of the NAS vulnerable to perturbation by OCS development.

As a result of these information needs, impact analyses in the Environmental Impact Statement (EIS) for the North Aleutian Basin Sale 92 (MMS 1985) were based in the case of juvenile salmonids on a series of broad generalizations regarding timing and movement patterns derived from the earlier purse seining reported by Straty (1974, 1975, 1981) and the subsequent synthesis meeting (Thorsteinson 1984).

A major goal of the present study was to evaluate the applicability of these generalizations, based mostly on data from outside the 20-m isobath, to fish distributions nearer to shore in habitats more vulnerable to effects of spilled oil. Thus, the research was designed to provide the baseline descriptions of fish assemblages needed to assess with greater confidence potential and actual impacts of oil and gas development on natural resources of the study area (Figure 2). Specific objectives were to:

- Describe the species composition of demersal and pelagic fish assemblages in poorly studied nearshore, intertidal, and estuarine habitats of the study area.

- Determine relative abundances of species by habitat, area, and season (spring, summer, and fall).

- Describe changes in distributions of adults and juveniles occurring over time scales of tide cycles to seasons, including inshore-offshore migrations and directed migrations through the study area.

- Characterize habitats in terms of physical properties and fish assemblages.

- Review and update the existing information base on Bristol Bay and north Alaska Peninsula salmon stocks (for both adults and juveniles).

This program emphasized the need to extend sampling to habitats not considered in previous investigations of fish movements in the NAS lease area.

2.2 CURRENT STATE OF KNOWLEDGE

2.2.1 Juvenile Salmonids

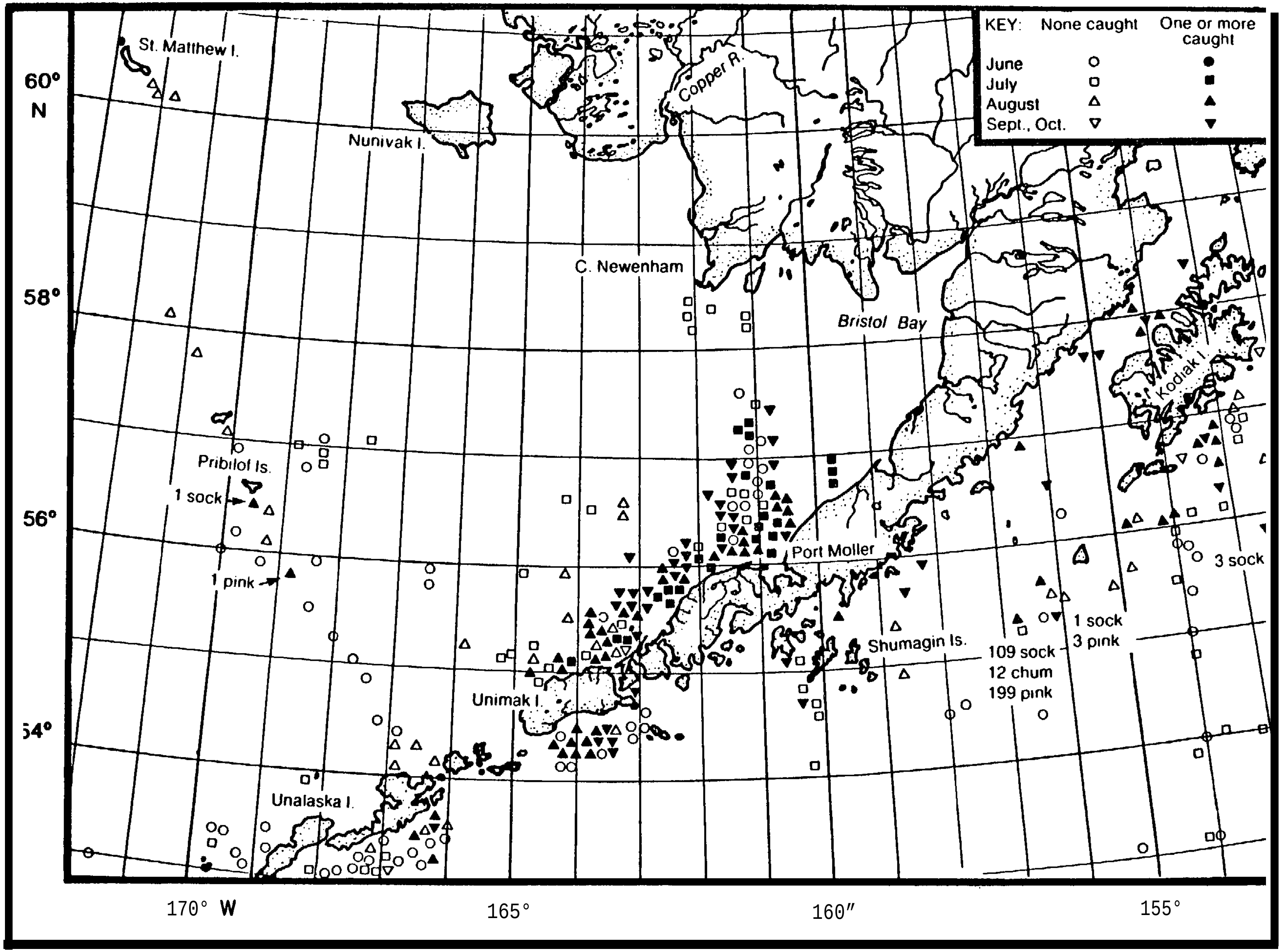
Of the inner Bristol Bay sockeye salmon (*Oncorhynchus nerka*) producing river systems, the smelt outmigrations from the largest system, the Kvichak, and from the Wood River Lakes system in the Nushagak District have been routinely assessed by the Alaska Department of Fish and Game (ADF&G). Smelt outmigration information for the other major producers (Naknek, Egegik, and Ugashik) is much less consistent, but at present these systems are also being assessed annually. Information on smolts produced in peninsula systems southwest of Ugashik is very limited, although data are available on adult escapement to these systems (ADF&G unpublished data; A. Schaul, ADF&G, personal communication).

The freshwater life-history of juvenile salmonids has been reasonably well studied in many major Bristol Bay systems. However, even this aspect has been largely unexplored in many Alaska Peninsula streams. In response to proposed oil pipeline and proposed heavy metal mining activity, the U.S. Fish and Wildlife Services (USF&WS; Lanigan and Wagoner 1985) studied the 1984 distribution of salmonids and other fishes in the Meshik River, which drains into Port Heiden. Dlugokenski (1985) provided details of planned 1985 field studies by USF&WS in Port Moller and Izembek Lagoon. These studies focused on resident and anadromous fishes of local streams and adjacent marine areas. The results of those studies were not available as this text was written.

The early marine life-history of juvenile salmon in these inshore waters, in general, remained virtually unstudied. The significance of the inshore waters from Ugashik south for vast numbers of juvenile salmon from major systems in the inner bay is only hinted at by available data (e.g., Straty 1974; Hartt and Dell 1978; Figures 3 through 7 and Appendix F). Therefore, it can be concluded that the juvenile salmon resource at risk from the "lesser" systems close to areas of vulnerability to oil development is not thoroughly understood.

The abundances of juvenile salmon in the migrations from Bristol Bay were expected to be much different in 1984-85 than they were in 1969-70,

Figure 3



Locations of Purse Seine Sets in the Eastern Bering Sea and South of the Alaska Peninsula, by Month, 1956-1968, Plus Indication of Presence or Absence of Juvenile Salmon
Multiple sets not shown If symbols Identical.

Source: Hartt and Del 1 1978

Note: See Appendix F for species breakdown.

Dames & Moore

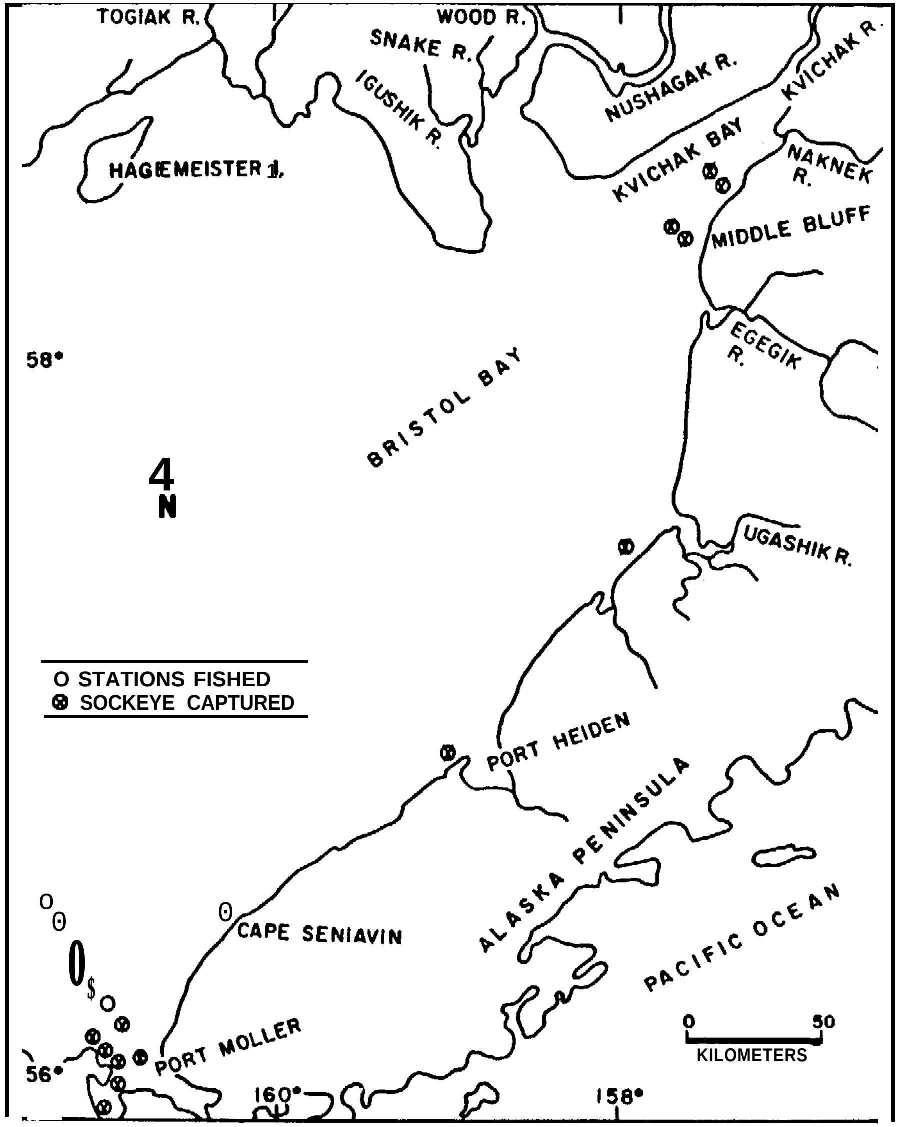


Fig. 4 Stations Fished by **Lampara** Seine and Locations of Capture of Seaward-Migrating Sockeye **Salmon** in inner and Outer **Bristol** Bay, June-August 1967

Source: Straty 1974

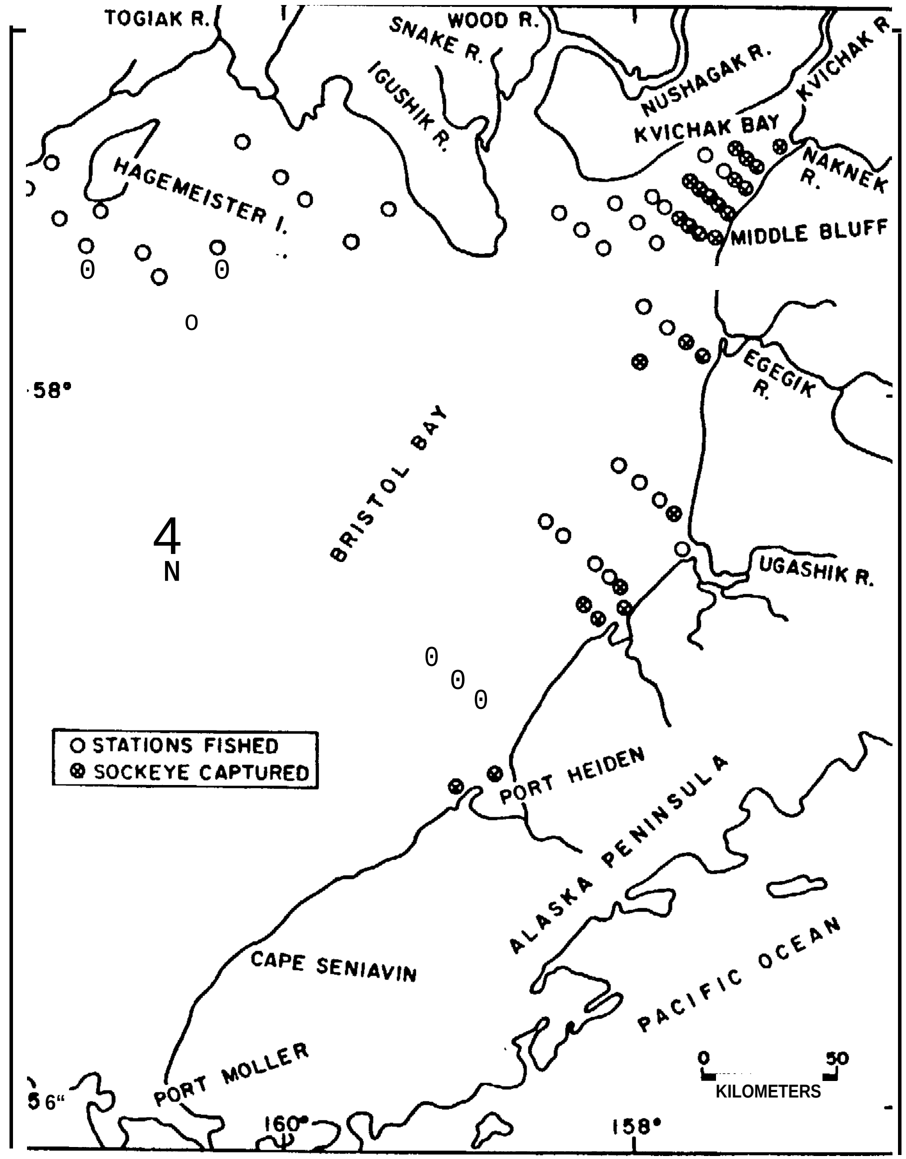
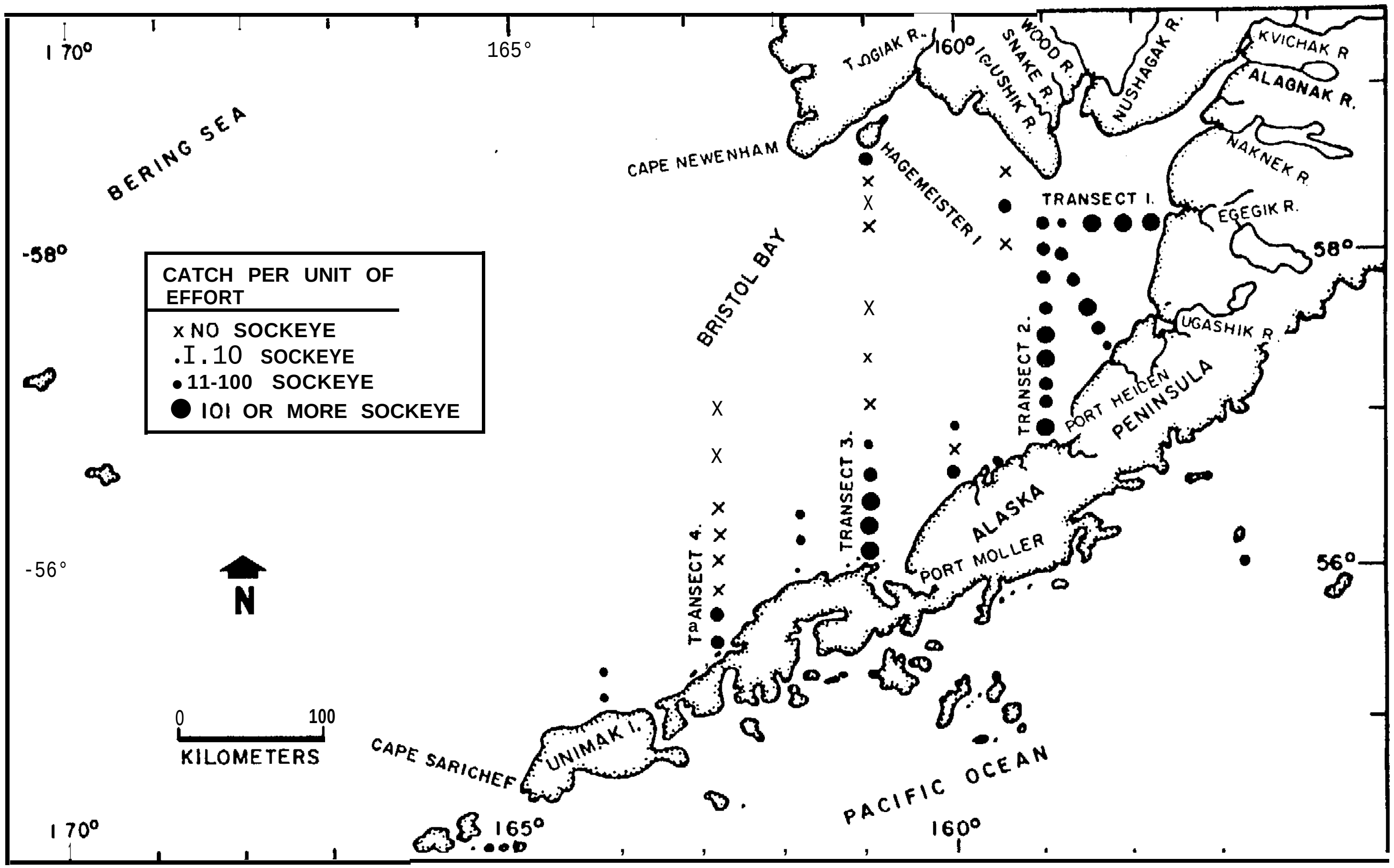


Fig. 5 Stations Fished by Tow Nets and Seining ● nd Locations of Capture of Seaward-Migrating Sockeye **Salmon** in inner **Bristol** Bay, June-September 1966



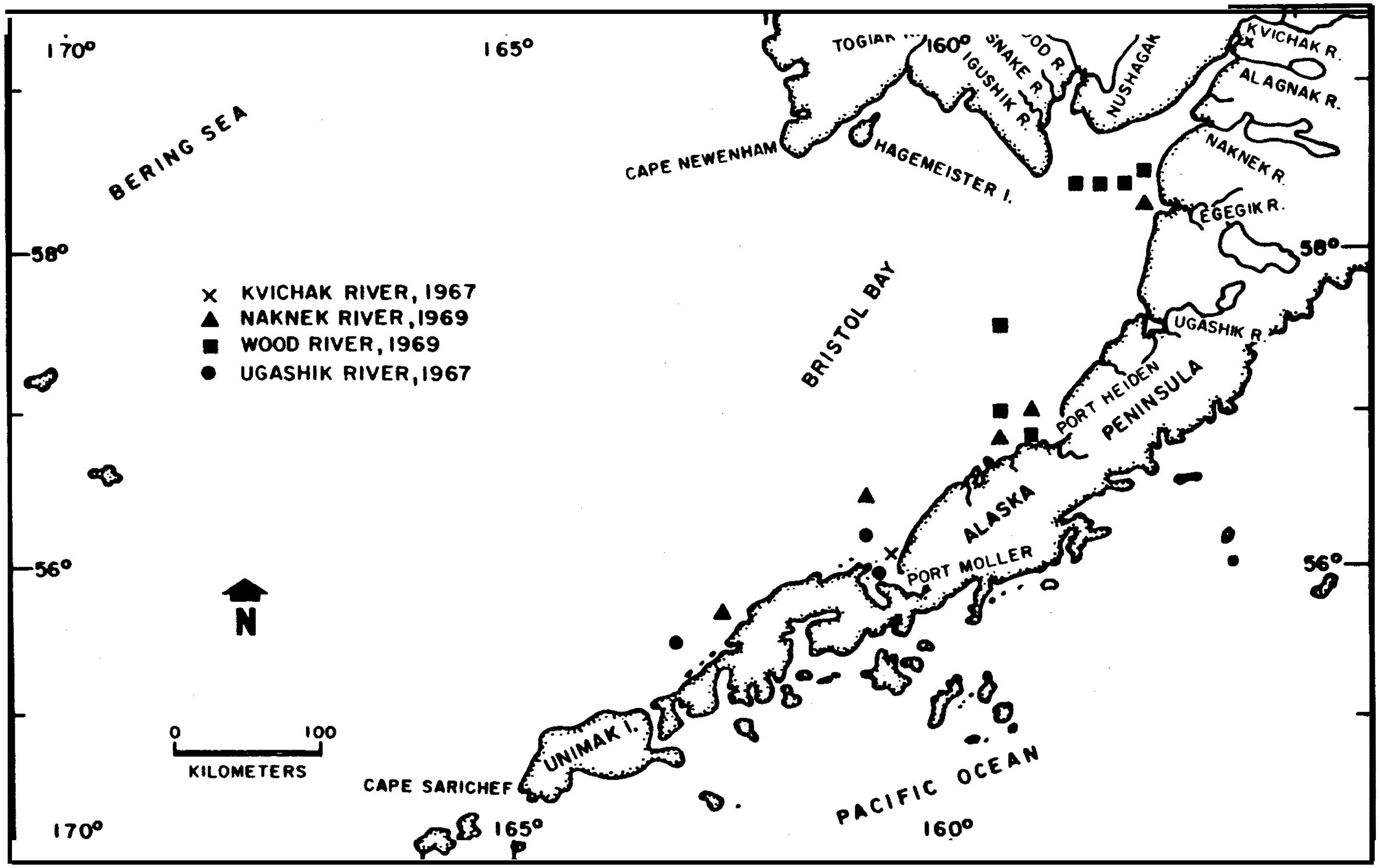
Relative Abundance (Catch per Unit Effort) of Seaward-Migrating Sockeye Salmon at 10 Mile Intervals on Four Transects Located in Inner and Outer Bristol Bay, June-August 1969.

Source: Straty 1974

Figure 6

Dames & Moore

W7



Location of Capture of Marked Seaward-Migrating Sockeye Salmon, Bristol Bay, 1967 and 1969

Source: Straty 974

as reported by Straty (1974; Figure 6). The parent escapements for the chum (O. keta) and chinook (O. tshawytscha) migrants in 1984 and 1985 were about double the escapements for the migrants in 1969-70. Coho (O. kisutch) abundance has increased since 1977, and although escapements are unknown, it is likely that there was a larger number of juveniles in 1984 and 1985 than there was in 1969-70. Pink salmon (O. gorbuscha) juveniles were expected to be scarce in 1984 since odd-year runs of adults are very small; however, they were expected to be abundant in 1985 since there was a good run of adult pinks in 1984. The parent sockeye salmon escapements for the smelt migrations in 1984-85 were about 22 percent larger than the parent escapements for the 1969-70 migrations; but more important is the fact that the distribution of the escapements among the Bristol Bay stocks was quite different between the 1969-70 migrants and those occurring in 1984-85. The Ugashik and Nushagak stocks should have produced a much greater number of smelts in the 1984-85 migrations than they did in the 1969-70 migrations, and the Naknek-Kvichak stocks should have produced fewer smelts in the 1984-85 migrations; however, they probably still produced more smelts than any of the other Bristol Bay stocks. Although smelt/fry outmigrant numbers from lower Alaska Peninsula streams are small, relative to the Kvichak and other larger systems, they are locally important and may be at higher risk due to their proximity to potential oil development areas.

Even though data from Straty (1974) and Hartt and Dell (1978) are pertinent to the more offshore regions of the study (e.g., greater than 15 nautical miles offshore; Figures 3 through 7), several important questions about the distribution of juvenile salmonids remain unanswered. The larger adult escapements and smelt/fry outmigrations in the mid-1980s may have altered the temporal and spatial distributions of juvenile salmon abundance relative to those seen in the years of earlier work. Furthermore, the fact that few chum or pink salmon juveniles were taken in purse seines may mean that the (presumably) smaller chum and pink fry escaped through the mesh, or that they simply were not offshore in the vicinity of sampling. A central question is whether juveniles of these species are more dispersed from nearshore areas, or are denser in nearshore areas. While quantitative comparisons are difficult with the level of effort available, we had at least hoped to conclude whether juvenile salmonid numbers are significant in the nearshore areas relative to the areas studied by Straty (1974) and Hartt and Dell (1978).

LGL Ecological Consultants (1985) provided limited information on juvenile salmon in the study area from their 1984 sampling effort, but few were taken in their catches because of gear selectivity and timing of sampling efforts in the pelagic environment. LGL (1985) did report some 95 chum salmon taken in Izembek Lagoon with gill nets and beach seines in July 1984, and from this effort and other studies, concluded that this species was a dominant summer transient in the lagoon. LGL (1985) also reported on the stomach contents of a total of 47 adult sockeye and chum salmon (June 1985), as well as 49 juvenile sockeye, pink, and chum salmon (July 1985). From these data, they derived some estimates of the quantities of prey species consumed in Bristol Bay by adult and juvenile salmon.

2.2.2 Pelagic and Demersal Marine Fishes

2.2.2.1 previous Work

Information about the occurrence of approximately 64 marine and/or anadromous fishes within the nearshore (< 50 m) waters of Bristol Bay, from Cape Sarichef to Cape Newenham, is available from seven sources: McRoy and Peden (1964), Tack (1970), Baxter (1976), Stern et al. (1976), McMurray et al. (1984), Grabacki (1984), and LGL (1985) (Table 2). Approximately 54 species are strictly marine.

The fishes of Izembek Lagoon have been assessed in several separate studies using a variety of methods. McRoy and Peden (1964) sampled the lagoon in early August 1963 and late August 1964 using an otter trawl, a beach seine, and a gill net, in addition to rotenone. Collections by these means yielded 26 fish species (Table 2).

A small otter trawl and a push net were used to quantitatively sample the fishes of Izembek Lagoon during July and August 1968 (Tack 1970). Twenty-five species of fish belonging to 11 families were taken during this study (Table 2). Although the numbers of species taken by

TABLE 2

LIST OF FISHES WITHIN SHALLOW (<50 M) MARINE WATERS FROM CAPE SARICHEF TO CAPE NEWENHAM

Scientific Name[a]	Common Name[a]	Source[b]
Raja aleutica Gilbert	Aleutian skate	1
Clupea harengus pallasi Valenciennes	Pacific herring	2,3,8
Oncorhynchus gorbuscha (Walbaum)	pink salmon	4,5
Oncorhynchus keta (Walbaum)	chum salmon	3,4,5,7,8
Oncorhynchus kisutch (Walbaum)	coho salmon	4,5,8
Oncorhynchus nerka (Walbaum)	sockeye salmon	4,5
Oncorhynchus tshawytscha (Walbaum)	chinook salmon	4,8
Salmo gairdneri Richardson	steelhead	4
Salmo clarki Richardson	cutthroat trout	4
Salvelinus malma (Walbaum)	Dolly Varden	3,4,5,7
Osmerus dentex = O. mordax (Mitchill)	rainbow smelt	2,3,5,7,8
Hypomesus pretiosus (Girard)	surf smelt	3,5,7
Hypomesus olidus (Pallas)	pond smelt	8
Mallotus villosus (Muller)	capelin	1,2,5
Thaleichthys pacificus (Richardson	eulachon	8
Boreogadus saida (Lepechin)	Arctic cod	2
Eleginus gracilis (Tilesius)	saffron cod	3,8
Gadus macrocephalus (Tilesius)	Pacific cod	1,2,3,5,7,8 5
Theragra chalcogramma (Pallas)	walleye pollock	1,3
Gasterosteus aculeatus (Linneaus)	threespine stickle-backs	3,5
Pungitius pungitius (Linneaus)	ninespine stickle-backs	8
Trichodon trichodon (Tilesius)	Pacific sandfish	1,2,8
Stichaeidae	pricklebacks	1
Lumpenus mackayi?	prickleback	2
Lumpenus sagitta Wilimovsky	snake prickleback	2,8
Lumpenus fabricii (Valenciennes)	slender eelblenny	8
Pholis laeta (Cope)	crescent gunnel	3,5,8?
Anarhichas orientalis Pallas	Bering wolffish	2,8
Ammodytes hexapterus Pallas	Pacific sand lance	1,2,3,5,7,8
Hexagrammidae	greenings	1
Hexagrammos stelleri Tilesius	whitespotted greenling	2,3,5,7,8
Hexagrammos octogrammus (Pallas)	masked greenling	3,5,8
Hexagrammos supercilious = H. lagocephalus	rock greenling	5
Cottidae		
Blepsias bilobus Cuvier	crested sculpin	8
Leptocottus armatus Girard	Pacific staghorn sculpin	3,5,7

TABLE 2 (Continued)

Scientific Name[a]	Common Name[a]	Source[b]
Artediellus miacanthus?	sculpin	2
Artedius fenestralis Jordon & Gilbert	padded sculpin	5
Enophrys diceraus (Pallas)	antlered sculpin	8
Eurymen gyrinus? Gilbert & Burke	"smooth cheek" sculpin	8
Enophrys claviger?	sculpin	2
Gymnocanthus galeatus Bean	armorhead sculpin	2,8
Hemilepidotus jordani Bean	yellow Irish lord	1,5
Hemilepidotus hemilepidotus (Tilesius)	red Irish lord	5
Megalocottus platycephalus (Pallas)	belligerent sculpin	2,8
Microcottus sellaris (Gilbert)	brightbelly sculpin	1,2,3,8
Myoxocephalus axillaris?	sculpin	2
Myoxocephalus mednius?	sculpin	3
Myoxocephalus niger (Bean)	warthead sculpin	3
Myoxocephalus jaok (Cuvier)	plain sculpin	1,2,8
Myoxocephalus quadricornis (Linnaeus)	fourhorn sculpin	2
Myoxocephalus scorpius (Linnaeus)	shorthorn sculpin	2,8
Myoxocephalus polyacanthocephalus (Pallas)	great sculpin	5
Blepsias cirrhosus (Pallas)	silverspotted sculpin	3
Nautichthys pribilovius (Jordan & Gilbert)	eyeshade sculpin	2
Icelinus borealis Gilbert	northern sculpin	3
Triglops pingeli Reinhardt	ribbed sculpin	1,2,8
Agonidae	poachers	1
Agonus acipenserinus Tilesius	sturgeon poacher	1,2,3,5,8
Occella dodecaedron (Tilesius)	Bering poacher	1,2,5,8
Pallasina barbata (Steindachner)	tubenose poacher	2,3,5,7,8
Liparis cyclopus Gunther	ribbon snailfish	2,5,8
Liparis cyclostigma Gilbert	polka-dot snailfish	8
Liparis sp.	snailfish	2
Hippoglossus stenolepis Schmidt	Pacific halibut	1,5,7,8
Hippoglossoides elassodon (Jordan & Gilbert)	flathead sole	1,8
Limanda aspera (Pallas)	yellowfin sole	1,2,3,7,8
Limanda proboscidea Gilbert	longhead dab	1,2,3,8
Liopsetta glacialis (Pallas)	Arctic flounder	2
Lepidopsetta bilineata (Ayres)	rock sole	1,3,7,8
Platichthys stellatus (Pallas)	starry flounder	1,2,3,5,7,8
Pleuronectes quadrituberculatus Pallas	Alaska plaice	1,2,8
Glyptocephalus zachirus Lockington	Rex sole	8

[a] after Robins et al. 1980, except for species followed by "?".

[b] 1 = McMurray et al. 1984
2 = Baxter 1976
3 = Tack 1970
4 = Stern et al. 1976
5 = McRoy and Peden 1964
7 = LGL 1985
8 = Grabacki 1984

McRoy and Peden (1964) and Tack (1970) were similar, the composition was very different with a combined total from both studies of 37 species.

A third study in Izembek Lagoon, which focused on the osmoregulation of the fishes, was made during July and October 1970; April, August, and October 1971; and May 1972. A small otter trawl was used along with a beach seine, a gill net, a hoop net, and a push net (Smith and Paulson 1977). A total of 23 fish species was collected; only two species were not on the previous list of 37. The two new species, the sculpins, Arctic sculpin (Myoxocephalus scorpioides) and M. axillaris, are thought to be synonymous (R. Baxter, Bethel, AK, personal communication 1985).

Most of the fishes collected by Tack (1970) were juveniles. Four species were anadromous: chum salmon, Dolly Varden (Salvelinus malma), rainbow smelt (Osmerus mordax), and surf smelt (Hypomesus pretiosus). Eleven benthic, nine demersal, and five pelagic species were also taken. The 11 benthic species included five species of sculpins (Cottidae) and four species of flatfish (Pleuronectidae). The cods (Gadidae) and greenings (Hexagrammidae) made up over half of the nine demersal species. The pelagic species were herring (Clupeidae), smelts (Osmeridae), and salmonids (Salmonidae). With the exception of the cods and the flatfishes, yellowfin sole (Limanda aspera), rock sole (Lepidopsetta bilineata), and all other benthic and demersal species are known primarily from waters less than 30 m deep (Tack 1970).

Three distinct communities were identified in Tack's study: (1) the eelgrass community dominated by the tubenose poacher (Pallasina barbata) and the masked greenling (Hexagrammos octogrammus); (2) the channel community dominated by whitespotted greenling (H. stelleri); and (3) the sand flat community dominated by the Pacific staghorn sculpin (Leptocottus armatus).

Of the fishes collected by Smith and Paulson (1977), seven were identified as nearly year-round residents of the lagoon: surf smelt, threespine sticklebacks (Gasterosteus aculeatus), whitespotted and masked greenings, brightbelly sculpin (Microcottus sellaris), tubenose poacher, and Myoxocephalus axillaris. "Four species occurred only in the summer: crescent gunnel (Pholis laeta), Pacific staghorn sculpin, rock sole, and starry flounder (Platichthys stellatus).

In 1984 and 1985, LGL (1985) conducted evaluations of Izembek Lagoon as part of a larger study, and based on their field studies and those of others, they summarized this lagoon's fish assemblages as follows: "The dominant residents are the tubenose poacher, whitespotted and masked greenings, and surf smelt; the dominant summer transients are chum salmon juveniles and adults, sand lance, staghorn sculpin, pollock young-of-the-year, and Pacific cod. Herring and capelin may pass through the lagoon as well."

During August 1974 and June 1975, a resource assessment was made of the inshore (< 50 m) marine waters of northern Bristol Bay and lower Kuskokwim Bay (Baxter 1976). The resulting document provided information on the potential commercial fisheries within the 12-mile contiguous fishery zone of these two embayments. Only two organisms were recognized as being able to support a major commercial fishery, the Pacific herring (Clupea harengus pallasi) and the capelin (Mallotus villosus). Information on marine fishes was mainly obtained by demersal trawling, although longlining and intertidal surveys were also employed. A total of 32 fishes (31 marine species and 1 anadromous species [rainbow smelt]) were caught at 242 stations between Nushagak Bay and Cape Newenham (Table 2). The yellowfin sole was more than twice as abundant as any other species. Other common species, in decreasing order of abundance, were the brightbelly sculpin, the longhead dab (Limanda proboscidea), the armorhead sculpin (Gymnocanthus galeatus), the whitespotted greenling, and the plain sculpin (Myoxocephalus jaok).

Demersal trawling for juvenile king crab in Bristol Bay and along the NAS in the summer of 1983 yielded 23 incidentally caught marine fishes between depths of 20 and 50 m (McMurray et al. 1984) (Table 2). Common fishes, in decreasing order of abundance, included yellowfin sole, rock sole, Pacific halibut (Hippoglossus stenolepis), Alaska plaice (Pleuronectes quadrituberculatus), longhead dab, Pacific cod (Gadus macrocephalus), and miscellaneous sculpins.

In autumn 1983 and spring 1984, Dames & Moore (Grabacki 1984) completed test fishing with pair trawls, longlines, and crab pots in inner Bristol Bay and down the Alaska Peninsula as far as Port Heiden. This study, to evaluate fishing opportunities outside of the salmon season, produced catch and distribution data on 42 fish species, as well as an assortment of invertebrates (Table 2). Length-frequency information was collected for selected fish species of importance.

In 1984 and 1985, NOAA-sponsored studies (LGL 1985) were completed in waters inside the 50-m isobath from Cape Mordvinof (Unimak Island) to Cape Seniavin (midway between Port Moller and Port Heiden). The fish portion of this study found that "several dominant species characterize the fish communities in three coastal habitats:

1. Nearshore zone (0-10 m water depth): sand lance, herring, capelin, salmon, yellowfin sole, rock sole, smelt, greenling and others;

2. Pelagic zone (out to 50 m water depth): sand lance, pollock young-of-year, salmon; and

3. Demersal zone (out to 50 m water depth): yellowfin and rock sole, pollock, Pacific cod."

Juvenile flatfish are the primary component of the inshore demersal communities. The dynamics of flatfish assemblages have not been studied in the Bristol Bay nursery areas. Examples of such studies can be found in the nursery grounds of Atlantic plaice and sole (Steele and Edwards 1970; Rauck and Zijlstra 1978), and English sole (Laroche and Holton 1979; Thornburgh 1979). Juvenile flatfish assemblages have been noted for a hierarchy in relative abundance; generally one or two species will dominate. The composition of the assemblages may vary with abiotic factors and with the structure of the benthic community (i.e., eelgrass beds or open coast sandy bottoms). The relative densities of the eight principal flatfish species expected in the project area may vary with these conditions, indicating the importance of a particular area as a nursery ground. The settlement and rearing areas of Pacific haiibut were of particular interest because of its commercial importance and because relatively little is known. Previous sampling has indicated that juvenile halibut are likely to be encountered inshore and there is some indication of spatial segregation correlated with temperature (IPHC unpublished data). The juvenile cod, pollock, and other species were expected to vary with distributions in a similar manner from area to area. With the exception of limited in-lagoon or bay studies (Tack 1970; Smith et al. 1978) and a recent manuscript (Hagen 1983), nearshore (e.g., less than 20 meters water depth) and inshore (e.g., less than 10 meters depth) fish populations along the Alaska Peninsula have been poorly studied up to this point.

2.2.2.2 Dominant Species

Based upon the studies summarized in the previous section, the dominant nonsalmonid fish species, in terms of abundance, in the near-shore waters in Bristol Bay are yellowfin sole, Pacific herring, and capelin. Information on these species and other less dominant species is summarized below.

Yellowfin sole - Limanda aspera

Yellowfin sole is the species which most dominates demersal fishes, and perhaps all marine fishes (by weight), within the nearshore zone of the Bristol Bay system (Baxter 1976; Cable 1981; Walters and McPhail 1982; Walters 1983; Grabacki 1984; McMurray et al. 1984; LGL 1985).

Yellowfin sole juveniles were only occasionally taken in the channels of Izembek Lagoon during the summer of 1968 (Tack 1970). Studies in 1984 and 1985 did not report this species as dominant here (LGL 1985). However, this species was the most common fish taken in the trawls in northern Bristol Bay in August 1974 and June 1975 (Baxter 1976). It occurred in all 242 successful trawls. A total of 2,030 yellowfin sole averaged 136.8-mm fork length (range = 50 to 337 mm). A sample of 284 fish included 168 males and 116 females. Males matured at a smaller size (90 to 120 mm) than females (170 to 200 mm). Sexually ripe fish of both sexes were taken in trawls in 20 m of water on June 7.

Deeper and shallower trawls took mature fish, but the fish were not as ripe at these depths as at 20 m.

Demersal trawling in Bristol Bay and along the NAS in the summer of 1983 revealed that the most abundant incidentally caught fish between depths of 20 and 50 m was yellowfin sole (McMurray et al. 1984). No size, sex, or maturity information has been reported.

Bottom trawls in the outer bay inside of 50 m in May and September (1984) and January (1985) yielded high biomass per unit effort for yellowfin sole relative to rock sole, Pacific cod, and pollock (LGL 1985). The spring 1984 sampling by Dames & Moore yielded an average CPUE for this species of 150 (rock sole was 324) for a cod-flounder trawl and 628 (rock sole was 72) for a shrimp-smelt trawl for the Pilot Point to Port Heiden area (Grabacki 1984). This area's CPUEs for yellowfin sole were much higher than the adjacent region farther up the bay (from Naknek to Egegik) but about the same as CPUES for the Dillingham to Togiak area (Grabacki 1984).

Similar findings of yellowfin sole dominance have been made from National Marine Fisheries Service trawl surveys. Numerical analyses of fishes and invertebrates in the eastern Bering Sea from the summer of 1971 through 1981 have delineated grouping relationships between all sampling locations, maps of these site groups, lists of the assemblages of species occurring within these groups, and their relative abundances (Walters and McPhail 1982; Walters 1983). Site groups were often identified in shallow nearshore regions from Cape Sarichef to Cape Newenham and, without exception, the fishes within these shallow site groups were always dominated by yellowfin sole. For example in 1981, a site group composed of seven stations in northern and southern Bristol Bay, at depths between 13 and 37 m,was dominated by yellowfin sole (Walters and McPhail 1982). Other fishes of less dominance that were often associated with _L. aspera_ in shallow waters were rock sole, Pacific cod, sculpins, Alaska plaice, starry flounder, and Pacific halibut.

Perhaps in response to the easing of fishing pressure, yellowfin sole populations have, since the mid-1970s, steadily approached and perhaps exceeded pristine stock levels. Recent biomass estimates for this species are in the 2 to 4 million metric ton (mt) range, making it the most common flatfish found on the shelf of the eastern Bering Sea, second only to walleye pollock in biomass (Bakkala 1981). In recent years, the Port Moller area has yielded approximately 35,000 mt of yellowfin sole to the commercial fishery (Bakkala et al. 1982).

Yellowfin sole migrate seasonally from outer continental shelf and slope waters (< 100 m) occupied in winter and early spring, to inner shelf waters (15 to 75 m) where spawning and intense feeding occurs during the summer (Bakkala 1981). The timing of spring inshore migrations is not well defined, although they have been observed starting from late April to mid-May over the three-year period of 1959 to 1961. Ice-induced delays to spring migrations are probably infrequent and of relatively short duration.

More than a million eggs are produced by each spawning female. Unlike the adults, the young remain in shallow nearshore nursery areas throughout their first few years of life. They begin to disperse to more offshore waters at 3 to 5 years of age (Fadeev 1970; Wakabayashi 1974).

The food and feeding habits of this species for a broader area, the eastern Bering Sea, have been summarized by Bakkala (1981) and are partially described here. Yellowfin sole are capable of feeding on a variety of animals, from strictly benthic forms such as clams and polychaete worms to zooplankton (mysids and euphausiids) and pelagic fishes (capelin and smelt). The kinds of organisms consumed vary by season, area, and size of fish. Contents of nearly 2,400 stomachs taken over a broad area of the eastern Bering Sea show that the primary food items, representing 65 percent of stomach contents by weight, were bivalves, amphipods, polychaete worms, and echiurid worms. Polychaetes and amphipods were the principal food items in smaller fish (10 to 20 cm); polychaetes, bivalves, echiurids and amphipods in larger fish (20 to 30 cm); and bivalves and echiurids in fish longer than 30 cm.

Although less is known about the food and feeding habits of the yellowfin sole in shallow waters, they are thought to be similar to those in deeper waters. Recent findings on the food of yellowfin sole in the southeastern Bering Sea along the Alaska Peninsula revealed that newly recruited surf clams (Spisula polynyma; 1 to 2 mm) were a favored prey (in the range of 100 to 500/stomach) in waters less than 30 m off Port Moller, while various groups of polychaete worms, benthic amphipods, and the sand dollar (Echinarachnius parma) dominated in depths of 30 to 50 m in Bristol Bay and greater than 30 m depths off Port Moller. King crab (Paralithodes camtschatica) glaucothoe larvae and Tanner crab (Chionoecetes bairdi) zoea were also taken as food in small quantities (Haflinger and McRoy 1983).

Food of yellowfin sole collected in Bristol Bay and along the NAS between 20 and 50 m in the summer of 1983 was diverse (McMurray et al. 1984). Prey items included sea cucumbers, miscellaneous clams, euphausiids, the crab Oregonia gracilis, heart urchins, brittle stars, ascidians, and Pacific sand lance (Ammodytes hexapterus).

On the basis of percent by weight of foods eaten by yellowfin sole in 1984 studies, LGL (1985) found the following patterns of prey dominants: during May at 20 m bivalves (42 percent), euphausiids (27 percent), and decapods (16 percent) dominated; in September at 20 m, bivalves and amphipods comprised 97 and 1 percent of the diet, respectively; in September at 3 to 10 m, decapods and amphipods made up 55 and 45 percent of the diet, respectively.

The only known natural predators of yellowfin sole in shallow coastal waters are sea otters (VTN Oregon 1984) and Pacific halibut (Novikov 1964).

Longhead Dab - Limanda proboscidea

The longhead dab was the second most abundant flatfish in the 1974-75 trawl surveys in northern Bristol Bay (Baxter 1976). The size of this fish averaged 124.1 mm and ranged from 53 to 296 mm (N = 456). Both sexes were encountered during June and August samplings. Average fork lengths for males and females were 121.7 mm (N = 76) and 140.9 mm (N = 25), respectively. Only a few transient juvenile longhead dab were caught in Izembek Lagoon in 1968 (Tack 1970). Longhead dabs were taken in the Dames & Moore studies from Bristol Bay down to the Port Heiden and Cinder River vicinity, but were not reported in any significant numbers (Grabacki 1984). This species is not mentioned in the LGL (1985) studies in the outer Bristol Bay area to water depths of 50 m. Nothing is known about the extent to which this species uses these nearshore waters.

Pacific Herring - Clupea harengus pallasi

Although yellowfin sole dominate the demersal marine fishes in the nearshore region in the vicinity of Bristol Bay, Pacific herring presumably dominate the pelagic marine fishes, at least seasonally. The abundance of herring in the eastern Bering Sea appears to have increased since 1978 in all major coastal areas. Total spawning biomass is estimated to have ranged from 187,210 to 334,723 mt in 1978, and from 258,079 to 637,583 mt in 1979, an approximate 27 percent increase at the lower range (Wespestad and Barton 1981). Studies have shown that Bristol Bay contains the largest assemblage of spawning herring within the entire State of Alaska: in 1983 about 127,000 mt of herring arrived to spawn in the Togiak region of Bristol Bay; 24,486 mt or 19.3 percent of the biomass was harvested (Fried and Whitmore 1983).

Herring usually spawn in areas where the shoreline morphology includes cliffs or bluffs with large jagged outcropping. Spawning substrates consist primarily of rocks covered with rockweed (Fucus sp.). However, almost any substrate (e.g., Laminaria spp., bare rocks, gill nets) are used under conditions of dense spawning. Herring also spawn in shallow bays, beaches or slough areas where eelgrass (Zostera spp.), and roots of rye grass (Elymus spp.) and sedges (Carex spp.) are exposed at low tide. In northern Bristol Bay most spawning is confined to the intertidal zone down to depths of 5 meters. The main spawning area between Ugashik Bay and Cape Newenham are in Metervik Bay and along the coast west to the village of Togiak (Barton et al. 1977; Wespestad and Barton 1981). The primary spawning areas between Ugashik Bay and Cape Sarichef are Herendeen Bay, inner Port Moller, Port Heiden, and, to a lesser extent, the north coast of Unimak Island (Barton et al. 1977;

Wespestad and Barton 1981). Adult herring were commonly found in Izembek Lagoon during the summer of 1968 (Tack 1970).

Few herring were taken in studies that included the Port Moller/Herendeen Bay area in 1984 and 1985 by LGL (1985). This was likely due to both the timing of cruises and gear used in sampling. Only 2 of 8 shrimp-smelt trawls in the spring 1984 sampling in the Pilot Point to Port Heiden area captured herring (12 fish) (Grabacki 1984) probably because of the locations, times, and gear fished. This same study did capture 2,516 herring in one spring 1984 shrimp-smelt trawl set in the Dillingham-to-Togiak area. Length-frequencies of a subsample of these herring are also reported (Grabacki 1984).

Most of the domestic herring harvest is taken with purse seines and gill nets in northern Bristol Bay between Cape Constantine and Cape Newenham. The majority of herring fishing by local residents in this area is for commercial purposes, although most fishermen retain a limited amount for subsistence needs (Dames & Moore 1978).

Herring eggs hatch in 10 to 21 days, depending on the temperature. Feeding begins after approximately two weeks when the yolk sac is absorbed. Evidence indicates that juvenile herring utilize the nearshore region of the Bristol Bay vicinity as nursery areas, but the duration of dependence on the nearshore waters is uncertain. Barton (1979) captured age 1 herring in June in Hagemeister Strait of northern Bristol Bay. Farther north in Port Clarence and inner Kotzebue Sound, juveniles (age not specified) have been found during the spring spawning period, suggesting that overwintering had occurred nearshore (Barton 1978). In the western Bering Sea, age O and 1 fish inhabit areas of lower temperatures nearer shore than adults (Prokhorov 1968). Ichthyoplankton studies in the southeastern Bering Sea in the summer and fall of 1975 and the summer of 1976 found a few herring larvae 200 km offshore near the 50-m isobath (Waldron 1981). These young individuals may be caught in offshore transport and presumably perish.

A summary of Pacific herring food and feeding habits from the Bering Sea is reported by Wespestad and Barton (1981) and is partially presented here. The first food of herring larvae is usually limited to small and relatively immobile planktonic organisms. Microscopic eggs sometimes make up more than half of the earliest food; other items include diatoms and nauplii of small copepods. Herring do not have a strong preference for specific prey, but feed on the comparatively large organisms that predominate in the plankton of a given area. Feeding generally occurs before spawning and intensifies afterward. During winter, feeding declines: it ceases in late winter.

In the eastern Bering Sea in August nearly 84 percent of the stomachs were filled with euphausiids, 8 percent with fish fry, 6 percent with calanoid copepods, and 2 percent with gammarid amphipods. Fish fry, in order of importance, were walleye pollock, smelt, capelin, and Pacific sand lance. In spring, food was mainly pelagic amphipods (Themisto spp.) and chaetognaths (Sagitta spp.). After spawning, the main diet was euphausiids, Calanus spp., and Sagitta spp. Nearly 75 percent of herring stomachs examined in the spring from Bristol Bay to Norton Sound either were empty or contained only traces of food. Only 25 percent of the stomachs examined were at least 25 percent or more full, and only 3.4 percent were completely full. Major food items were cladocerans, flatworms, copepods, and cirripeds.

Herring are important prey for marine mammals (i.e., harbor seals, sea lions, and beluga whales), sea birds (i.e., black-legged kittiwakes and glaucous gulls), 'and fishes (chinook and coho salmon) (Hart 1973; Wespestad and Barton 1981; Warner and Shafford 1977). Concentrations of flatfishes, particularly yellowfin sole, have been observed on the herring spawning ground in northern Bristol Bay (John Clark, ADF&G, personal communication, as cited in Wespestad and Barton 1981). Stomachs of flatfishes examined in this spawning area have revealed a high rate of herring egg consumption (Wespestad and Barton 1981).

Capelin - Mallotus villosus

In 1976, capelin was the most geographically widespread forage fish species encountered in the eastern Bering Sea and constituted the second-most abundant species, next to Pacific herring, captured at onshore stations between Ugashik Bay and Unimak Island (Barton et al. 1977). Capelin typically spawn from May through July along clean, fine gravel beaches; however, spawning has been documented at depths of 60 m (Barton et al. 1977; Musienko 1970; Warner and Shafford 1977). Barton et al. (1977) and Baxter (1976) reported that the only spawning areas that capelin have been observed to utilize between Ugashik Bay and Cape Newenham occur in Togiak Bay, north of Hagemeister Strait, and around Hagemeister Island. During spawning in June 1975, capelin were utilizing all the fine gravel beaches between Nushagak Peninsula and Cape Newenham (Baxter 1976). Spawning and schools of unspawned capelin were observed from May 30 to June 15, 1975. Spawning appeared to progress with time from the south to the north. Much of the region between Ugashik Bay and Cape Seniavin on Unimak Island is presumably suitable for spawning since capelin have been observed washed up on the beaches from Cape Krenitzen north to Smoky Point at Ugashik Bay (Barton et al. 1977).

Few capelin were taken in 1984 sampling between Unimak Island and Cape Seniavin inside of 50 m by LGL (1985). This was likely due to the locations, times, and gears fished. The spring 1984 Pilot Point-to-Port Heiden capelin catches by cod-flounder trawl and a shrimp-smelt trawl had CPUEs of 1 and 235 fish per hour of sampling, respectively (Grabacki 1984). In contrast, fewer capelin were taken in the same gear types during the same period in the Dillingham-Togiak area and no capelin were taken in the Naknek-Egegik area.

Subsistence utilization of capelin is minor, with some taken by dip net along the north side of Togiak Bay from near Togiak village to Tongue Point (Baxter 1976).

Little is known about the food and feeding habits of capelin in the shallow regions of Bristol Bay. Smith et al. (1978) examined the stomach contents of 135 feeding individuals from the southeastern Bering Sea. All specimens were captured from late spring to early fall, therefore, no information is available on seasonality of feeding in the Bering Sea. Only two phyla were represented among the food organisms, Arthropoda (all crustaceans) and Chaetognatha. The most numerous prey organisms were calanoid copepods, specifically the genus Calanus. Virtually all of the amphipods present were members of the pelagic family Hyperiidae. Identifiable euphausiid specimens were all of the genus Thysanoessa. The smallest food item, copepods, had its greatest volumetric and relative importance in the smallest fish. The same is true of the next smallest food items, the mysids.

Capelin are food for a variety of predators, including seabirds of the family Alcidae and fishes (e.g., chinook and coho salmon, arrowtooth flounder, walleye pollock, and Greenland halibut) (Hart 1973; Macy et al. 1978; Vesin et al. 1981).

Sculpins - Cottidae

Sculpins are the most diverse group of fishes (approximately 21 species - Table 2) within the study area, specifically among the gravel-rock substrates of northern Bristol Bay. Approximately 10 species have been taken from Izembek Lagoon.

The brightbelly sculpin was the most common sculpin in the 1974 and 1975 surveys (Baxter 1976). A sample of 490 fish had an average length and range of 81.2 mm and 43 to 141 mm, respectively. This species is considered to reside in Izembek Lagoon for most of the year (Smith and Paulson 1977).

In 1984 and 1985 studies in the nearshore habitats (0-10 m) from Unimak Island to Cape Seniavin, Pacific staghorn sculpin made up 33 percent by number (17 percent by weight) of 22 gillnet sets and 14 percent by number (54 percent by weight) of 38 beach seine sets (LGL 1985). In Izembek Lagoon (0-5 m), this sculpin made up 62 percent by number of all fish caught in 5 gillnet sets in this same study. Autumn 1983 and spring 1984 studies by Dames & Moore in inner Bristol Bay (down as far as Cinder River) took nine species of sculpins but not the Pacific staghorn sculpin (Grabacki 1984). Sculpin CPUEs were not described for spring 1984 sampling down the Alaska Peninsula in this study. However, sculpins ranked fourth in pounds of fish caught per hour in cod-flounder trawls and fifth in shrimp-smelt trawls in Autumn 1983 studies in the Dillingham-Togiak area (Grabacki 1984).

The armorhead sculpin that were sampled in northern Bristol Bay averaged 127.1 mm (range = 47 to 219 mm; N = 333) in fork length (Baxter 1976). This species is known to reach approximately 360 mm in length (Eschmeyer et al. 1983). Although it was commonly found among shallow rocky substrate, its habitat is reported to be on soft bottoms near shore to 167 m, and most commonly below 50 m (Eschmeyer et al. 1983). Other parameters of this species are not known.

The plain sculpin was the most abundant of the seven species of the genus Myoxocephalus taken by Baxter (1976). It occurred throughout the study area. Its average size was 146.1 mm (range = 45 to 548 mm; N = 276). Food items consumed by this sculpin in the study were dominated by fish, specifically flatfishes, and a sculpin (Gymnocanthus) (McMurray et al. 1984). Other food included jellyfish, crangonid shrimp, and the crab Telmessus cheiragonus. Little is known about the extent of dependence of this species upon the nearshore regions of Bristol Bay.

Cods - Gadidae

The catches of Pacific cod, Arctic cod (Boreogadus saida), saffron cod (Eleginus gracilis), and walleye pollock (Theragra chalcogramma) within the nearshore region of Bristol Bay have been limited to a few small individuals. A fishery for Pacific cod was reported to have once existed around the Walrus Islands in the spring soon after the ice moved out of Togiak Bay (Baxter 1976).

In 1984 studies of demersal habitats (10-50 m) from Unimak Island to Cape Seniavin, Pacific cod made up 13 percent by number (32 percent by weight) of the catch in 16 gillnet sets and 8 percent by number of 98 try net sets (LGL 1985). In nearshore habitats (0-10 m) in this same study, Pacific cod made up 14 percent by number (3 percent by weight) of 38 beach seine sets. Spring 1984 trawling by Dames & Moore in the Pilot Point to Port Heiden area had CPUEs of 14 cod per hour and 64 cod per hour in shrimp-smelt and cod-flounder trawls, respectively (Grabacki 1984).

Until documented by Baxter (1976), Arctic cod had not been reported to extend farther south in the Bering Sea than Norton Sound, preferring low temperatures (< 7°C) (Morrow 1980). Spawning of the Arctic cod takes place during the winter (mainly January-February) when dense schools of fish move inshore (Morrow 1980). It is a demersal species feeding on a variety of benthic prey.

Whitespotted Greenling - Hexagrammos stelleri

The whitespotted greenling, along with the masked greenling, is an abundant species within Izembek Lagoon (McRoy and Peden 1964; Tack 1970). Apparently, it is a nearly year-round resident of Izembek Lagoon (Smith and Paulson 1977). The size of the whitespotted greenling that were captured during 1974-75 averaged 156 mm and ranged between 68 to 308 mm in fork length (N = 319) (Baxter 1976). This species is reported to attain lengths to 480 mm and to occur in waters shallower than 46 m in rocky regions near eelgrass beds (Eschmeyer et al. 1983). In August, females appeared to be near spawning since many contained well developed, purple-tan eggs (Baxter 1976). (To the south, in British Columbia waters, spawning occurs in April [Hart 1973]). The food consists of worms, crustaceans (copepods, amphipods, decapod larvae, ostracods, and barnacle larvae), fish eggs, and tunicates (Oikopleura) (Hart 1973).

This greenling, along with the masked greenling, was reported with two other species (tubenose poacher and surf smelt) as dominant residents of 0-3 m habitats in Izembek Lagoon (LGL 1985). The whitespotted greenling was taken in the autumn 1983 and spring 1984 studies in inner Bristol Bay, but no CPUE data were reported due to the low commercial fisheries potential of this species (Grabacki 1984).

Rainbow Smelt - Osmerus mordax

Baxter (1976) found only a few anadromous rainbow smelt in northern Bristol Bay; the largest catches, consisting of spawned-out fish, were made in Nushagak Bay in June. However, good runs have been reported in Nushagak and Togiak Rivers in the spring after the ice goes out (Baxter 1976). These smelt, presumably juveniles, have also been observed in Izembek Lagoon (McRoy and Peden 1964; Tack 1970). Little else is known about the life-history aspects or the residence time of the fish while within the nearshore zone of Bristol Bay.

In the Unimak Island-to-cape Seniavin demersal zone (10-50 m) and nearshore zone (0-10 m), rainbow smelt and sand lance were considered abundant in bottom trawls, especially in the shallower parts of the study area (LGL 1985). This smelt made up 10 percent by number of try net trawl catches (98 sets) in the demersal zone (LGL 1985). In nearshore habitats, rainbow smelt made up 42 percent by number (3 percent by weight) in 22 gill net sets, and 26 percent by number (11 percent by weight) in 38 beach seine sets (LGL 1985). Rainbow smelt ranked third behind yellowfin sole and capelin in shrimp-smelt trawl catches in the Pilot Point-to-Port Heiden area in spring 1984 sampling by Dames & Moore (Grabacki 1984).

There is a subsistence fishery for rainbow smelt consisting of a winter fishery at the mouth of the Togiak River. Local residents jig with hooks through the ice or along open leads (Baxter 1976). There also are fall and spring dip net or small seine fisheries in Nushagak and Togiak Bays.

3.0 METHODS AND MATERIALS

3.1 STUDY AREA AND SAMPLING DESIGN

A hypothetical oil spill scenario given as the context for discussion at the NAS Synthesis Meeting (Thorsteinson 1984) described the dispersion of oil eastward from a midsummer accident off Cape Seniavin or Amak Island. The plume resulting from a spill of 10,000 bbls over 5 days would probably extend 20 km in the direction of prevailing winds and currents and cover about 80 km2. Water column concentrations of petroleum hydrocarbons would be diluted rapidly to below lethal levels at the perimeter of the plume. It is likely that the area immediately eastward of these hypothetical spill sites, in particular the nearshore, intertidal, and estuarine zones, would be most severely impacted.

While the longer term oil development risk is expected to be near shore (inside 10 to 25 m) and in bays, the majority of available juvenile salmon data (Straty 1974, Hartt and Dell 1978) were from farther offshore (e.g., greater than 15 nautical miles, rim). Thus, our study area initially extended from False Pass to Ugashik Bay in waters to about 30 m deep (Figure 2). It originally encompassed two estuaries (Port Heiden and Port Moller) and a coastal lagoon (Izembek Lagoon), as well as exposed coastal and inshore habitats. A third estuary (Ugashik Bay) was sampled during the second 1984 cruise and added as a permanent transect in 1985. The estuarine systems are representative of those in inner Bristol Bay. Izembek Lagoon deserves special attention due to its highly productive character.

Our focus on the Alaska Peninsula coast, between False Pass and Ugashik Bay and inshore of the 30- to 50-m depth contour (excluding the north shore of Bristol Bay), stemmed from the study results of Straty (1974) and Hartt and Dell (1978). Their data (Figures 3 through 7) suggest that the north shore rivers produce salmonid juveniles which migrate nearshore to the Naknek-Kvichak area before turning southwest and moving seaward along the north shore of the Alaska Peninsula. Since neither Straty (1974) nor Hartt and Dell (1978) found significant numbers of juvenile salmonids on the north shore of Bristol Bay, we concluded that the logistics and travel time required to survey both areas would consume time and resources out of proportion to the amount of new information gained, and would preclude a comprehensive assessment of fish assemblages most vulnerable to NAS development within the time and cost constraints specified.

In 1984, our study area was divided into three subareas (Figure 2) by Loran C coordinates. The Izembek Lagoon subarea extended from False Pass to north of Cape Leisko; the Port Moller subarea continued from there to the vicinity of the Seal Islands; and the Port Heiden subarea extended to Ugashik Bay. These divisions were drawn to include estuarine or lagoon systems in each subarea. Six transects within the area were aligned, to the extent possible, to be inshore extensions of transects occupied for CTD studies by Schumacher and Moen (1983), and for sediment characterization and trawling by VTN Oregon Inc. (1984). A seventh transect was added at Ugashik (Transect O) in the second 1984 cruise. On each transect, offshore sampling with one or more gear types was planned at the beach and at 5-m, 10-m, 20-m and (purse seine only) 30-m stations. In practice, the 10-m station was moved to n-m to keep the purse seine clear of the bottom. Sample stations in each embayment were selected based on local bathymetry and exposure (Appendix A, Figures A-1 through A-4). Habitats sampled included sheltered and exposed intertidal, estuarine and offshore pelagic, and the inshore and offshore demersal.

In 1985, the study focus was shifted to achieve more spatial coverage sampling with gear types targeting juvenile salmonids; the study subareas remained the same but the number of transects was modified (Figure 2). The open coast transects (1, 3, and 5) were dropped and the transect at Ugashik (number O) in 1984 was included so that sampling occurred on transects O, 2, 4, and 6 only. In contrast to the depth-stratified outside stations in 1984, the 1985 sampling was distance-stratified from shore for the two offshore stations, and Station O was added at the most distant offshore location of each transect. Thus, the three most offshore stations (Stations O, 1, and 2) were 15, 10, and 5 nm offshore on each of the four transect lines. Stations 3 and 4, located between Station 2 and the beach, were left in their depth-stratified location as in 1984. No Station 3 was located on Transect O (Ugashik) since the water at Station 2 (5 nm from shore) was already at the n-m depth. Station 4 on Transect O was used to designate an open-coast beach seine location.

3.2 SCHEDULE

In 1984, the three study subareas along the Alaska Peninsula were each alloted a 7-day sampling period for each of three 21-day cruises. However, actual sampling efforts accomplished were very much a function of weather conditions, which were severe during the summer-fall of 1984. Because of time required for contracting, gear procurement, and mobilization, field sampling did not begin until June 26, 1984. Subsequent 21-day cruises began on July 25 and August 26.

The 1985 schedule was designed to cover the study area as many times as weather and logistics would allow. Therefore, we started at Port Moller and proceeded up and down the coast without repeating the end transects. Thus, the transect sampling sequence was: 4, 2, 0, 2, 4, 6, 4, 2, 0, and so forth. This pattern was continued for 6 weeks from June 16 to July 28.

3.3 FIELD METHODS

3.3.1 Salmonids and Pelagic Species - 1984

Gear types (Table 3) and methods were chosen to include proven nets for capturing smaller juvenile salmonids (including pinks and chums) and other species in nearshore habitats. Some gear types (large seines primarily) used in the past may have caught few chums and pinks because larger mesh sizes allowed them to escape, although Straty and Jaeneke (1981) reported catching some pinks in the 65-mm size range.

The ‘offshore” component of this study employed a 55-foot fishing vessel with a biologist/skipper (Robert D. Paulus) fishing a 229- by n-m (750- by 35-foot) purse seine. The net was patterned after that

TABLE 3

GEAR TYPES, HABITATS SAMPLED AND TARGETED FISH IN EACH HABITAT SURVEYED

Gear Type	Code	Habitat Type	Expected Fish Taxa
Beach seine (37-m; to 6-mm stretch mesh)	BS	Intertidal 1984 and 1985	Juvenile salmonids, demersal species
Tow net (6.1 x 3.1 m mouth; to 6-mm stretch mesh)	TN	Inshore/pelagic 1984 only	Juvenile salmonids, forage fish,
Beam trawl (3-m beam; 6-mm stretch mesh cod	BT	Inshore benthic 1984 only	Flatfish, other demersal fish
Try net (7.5-m mouth; 6-mm stretch mesh cod end)	OT	Demersal (inshore/offshore) 1984 only	Flatfish, other demersal fish
Purse seine (229 x n-m; 19-mm stretch body; 13-mm stretch bunt)	Ps	Offshore pelagic 1984 and 1985	Juvenile salmonids, forage fish
Small seine (67 x 4.6-m; 19-mm stretch body; 13-mm stretch bunt; 30.5-m attached lead panel of 19-mm stretch web)	SS	Inshore/pelagic 1985 only	Juvenile salmonids, forage fish

used and described by Johnsen and Sims (1973), and had a main body mesh size of 10-mm (3/8-inch) (bar) knotted nylon and a bunt of 6-mm (1/4-inch) (bar) knotless nylon, all dyed green. The net was set into the current in standard purse seine fashion and slowly towed (2 to 3 knots) for 10 minutes. Captured fish were brought aboard with a dip net and those surplus to sampling needs released with little damage. A minimum of two sets was planned at deeper (>10-m) stations on each transect in each sampling period.

The more “inshore” sampling effort in 1984 involved two smaller boats (30- and 16-foot) paired and pulling a surface tow net. Tow- net sampling was to be conducted only in 1984 concurrent with “beach seine sampling when possible. The two-boat tow net was planned to sample neritic fish occurring in the upper 2.5 m of the water column at the 5-m and 10-m stations. Again, stations were moved to 6 m and 11 m to avoid bottom contact with the gear and to provide consistency with the purse seine stations. The tow net was 14.9 m long, 6.1 m wide, and 3.1 m deep at the mouth (49 x 20 x 10 feet), and made of green nylon. "The stretch mesh sizes graded from 76-mm (3-inch) at the brail to 6-mm (1/4-inch) at the bag. The cod end had a zipper for opening and closing, and the foot rope and head rope had leads and floats, respectively, to ensure proper opening of the net. The net was attached to two vertical steel poles with a large float attached to each pole near the head rope connection to keep the net fishing upright at the surface. The net was towed at about 3.7 km/hr. Two 10-minute tows were planned at each station. One tow was planned with the prevailing tidal current along the shoreline, with the other tow planned in the opposite direction. In actual practice, with low success and limited time for tow nets in most areas, single tows were often made and vessel handling required most replicate sets to be towed in the same direction. Weather and wind often precluded any tow net activity.

When and where surf conditions permitted, beach seining was conducted using a 37-m (120-ft) floating beach seine, consisting of two wings with 3-cm (l-inch) stretch mesh joined to a 0.6-m x 2.4-m x 2.3-m (2- x 7.9- x 7.5-foot) bag with 6-mm (1/4-inch) stretch mesh. Replicate sets to sample fishes in the surface waters within 30 m of shore were made at each station and care was taken that the area swept by one set not be included in the replicate. The beach seine effort was expected to provide for two sets at each transect with replicated sets at, at least, two additional stations in each embayment. In reality, surf conditions permitted very little beach seining on exposed beaches.

The following was recorded for all sampling stations: location, date, time, weather conditions (wind force and direction, cloud cover, and general weather) , sea surface temperature, salinity, sea state and secchi, depth, area sampled (beach seine), distance fished, sampling duration, compass heading, and current direction.

All information was recorded on computer data forms following National Oceanographic Data Center (NODC) codes and format. Unless otherwise noted, all names of fishes, both scientific and common, were based on the American Fisheries Society (AFS 1980) list.

Catches were processed immediately or bagged, labeled, and preserved for later processing. Any fish to be retained for other concurrent studies (e.g., salmonid identification, food habits, stomach analysis) were separated from the catch and preserved in 10-percent formalin immediately after processing. Generally, catches were processed in their entirety. However, where catches were too large for complete handling, the less abundant species were sorted from the catch, counted and saved if salmonids. The abundant species were thoroughly mixed and a known volume greater than or equal to 10 percent of the sample was removed and saved. The volume of the remaining sample was measured or weighed before the fish we're discarded.

Incidental catches of fish larvae occurred even though our sampling gear was designed to sample larger fishes. Catches of larval forms were separated from the catch, preserved in 10-percent formalin immediately, and retained for further analysis if desired.

Fish samples were sorted to species and individuals counted, measured (fork length for salmonids, total length for others), and weighed (to the nearest 1 g wet weight). Problematic individuals, if any, were assigned a taxonomic designator and preserved for later taxonomic confirmation. If the number of individuals of a species in a sample exceeded 100, 50 or more individuals were counted, weighed, and measured; the remaining fish were counted and an aggregate weight taken, or the number was determined volumetrically. All information was recorded on computer data forms.

3.3.2 Salmonids and Pelagic Species - 1985

Gear types used in 1985 (Table 3) were selected based upon the 1984 experience to optimize capture of juvenile salmonids. With the low success of the tow net, it was replaced with the small purse seine in the "inshore" effort. For the most part, this small seine was fished in 1985 at stations where the tow net was used in 1984. The try net and beam trawls used in 1984 were dropped in 1985, reflecting the emphasis on pelagic species over demersal species. 'The large purse seine and the beach seine used in 1984 were fished in the same way in 1985, with one important exception. A 16-foot fiberglass seine skiff, using the same outboard engine used in 1984, was substituted for the 16-foot Boston Whaler used in 1984 as a skiff in the large purse seine operation. This " rea 1" seine skiff allowed the offshore effort in 1985 to be much less influenced by both wind and tidal current direction than 1984. While severe wind and sea state conditions stopped sampling in both years, the direction of 1985 large purse seine sets (up- or down-bay) was not dictated by wind and tidal current direction as in 1984. The first priority in large purse seine sets was to make all sets facing up-bay on an ebb tide. If time and weather permitted, a delayed "replicate" was often taken at each station with the set facing down-bay on the following flood tide. Some real replicates with both sets in the same direction and in close proximity in time were also made. However, the "replicates" on most days had 4 to 6 hours between them, were set in opposing directions, or were on opposing tides.

The "inshore" effort employed the small seine at Stations 3, 4, and inside each of three bays (Ugashik, Port Moller, and Izembek Lagoon); Port Heiden did not have stations inside of Station 3 suited for this gear type. The small seine was used from the 30-foot boat using an outboard-powered 14-foot inflatable boat as the seine skiff. The small seine, with lead panel attached, totaled 97.5 m by 4.6 m (320 feet by 15 feet) in length with 30.5 m (100 foot) being the non-purseable lead panel. The lead panel and main panel web of this seine was of 10-mm (3/8-inch) (bar measure) knotless nylon with a bunt of 6-mm (1/4-inch) (bar) knotless nylon, all dyed green. The lead panel was always attached between the boat and the seine so that it left the boat last and was retrieved first in sets that were made. In the actual seining effort, the skiff pulled the seine off the stern of the 30-foot boat forming a U-shaped arc in the set facing into the tidal current direction. The set was held open for 10 minutes if no difficulties were encountered. The skiff and larger boat then met with the net closed in a circle. The lead panel of the seine was then pulled in over the stern of the larger boat. With both ends of the purseable seine aboard, the net was pursed and fish were removed by dip nets and placed in buckets containing sea water. After all fish were removed from the small seine, it was restacked on the larger boat's stern in preparation for the next set. The small seine fished an area about 40 percent of that fished by the large seine.

All fish processing and information handling in 1985 was completed as in 1984 with two differences. The first difference was that all fish, both salmonids and non-salmonids, were processed for live weight and length. In later examinations of some juvenile salmonids, FRI biologists took preserved weights and lengths, as well as scales for the scale pattern analyses completed in 1985. In 1984, salmonids were weighed and measured after a minimal preservation period and no live lengths or weights were taken. The other difference was that a portable computer and printer were operated on the 55-foot vessel in 1985 to allow all data entry and checking to be done in the field during the evenings, travel times, and on weather days. This proved to be very successful and saved several man-months of time that took place in 1984 in Seattle with a similar data set.

3.3.3 Demersal Species - 1984

The same sample design described above in Section 3.3.1 and shown on Figure 2 was used for sampling demersal species as well. Several different gear types (Table 3) were employed to target demersal fish. However, all other demersal marine fish taken as a part of the pelagic (salmonid) program in both years were recorded for use in this characterization.

The generally uniform, sandy bottom inshore area of Bristol Bay lends itself well to an "area swept" method of comparing relative densities from different habitats. Care was given concerning some of the assumptions involved with this method. The primary gear types for demersal fish were try net (otter trawl) and/or beam trawl, and the beach seine.

The otter trawl (try net) used had the following characteristics: 7.5-m (25-ft) opening, 10.8-m (35-ft) total length, 3.8-cm (1-1/2-in) mesh in the body of the net, and 6-mm (1/4-in) mesh liner in the cod end (all stretch measure). This gear was comparable to that used in the 1983 red king crab surveys off the R.V. Miller Freeman (McMurray et al. 1984). The second gear was a plumb staff beam trawl with a 3-m (10-ft beam), 2.5-cm stretch webbing in the body with a 6-mm stretch mesh liner in the cod end. This net was thought to provide a better quantitative sample because the mouth is kept at a constant width by the beam. However, the beam trawl proved difficult to sample for standard times (10 min.) since it would foul and stop when filled with mud/sand. Because of its greater ease of use, the otter trawl was the primary gear used at all stations.

As with the salmonid sampling program, at least two replicates were planned with the otter trawl at each transect station (6-, 11-, and 20-m) and at additional stations within the embayments.

Sample handling, fish processing, and data recording for demersal fish were as described for the pelagic sampling in Section 3.3.1, with bottom sea temperature substituted for surface values.

3.3.4 Demersal Species - 1985

With tow net and try net dropped in 1985, only the beach seine was targeted on shallow water fish including demersal fish species. The large and small purse seine activities took incidental catches of normally demeral species or pelagic life stages of demersal species. The beach seine was operated in 1985 as in 1984. As with salmonids and pelagic species in 1985, replication of sampling was de-emphasized in favor of covering all planned stations. However, if time and conditions permitted, a beach seine replicate was often taken.

With the exception of the field computer described in Section 3.3.2, all fish processing and information handling from beach seine sampling was completed in 1985 as in 1984.

3.4 DATA LIMITATIONS

3.4.1 1984

Field plans could not be followed in all cases in 1984 because weather (high winds) produced sea state conditions (high waves) which precluded safe sampling, especially at the outside stations (l-5). The desired coverage and station replication were not achieved in all cruises. Only during Cruise 3 were all six transects sampled. When possible, inside water (bay) studies replaced some of those planned for Stations 1-5. On occasion (e.g., Port Moller, Cruises 1 and 3), weather was so bad that even inside work was limited.

Field sample processing procedures also had several limitations. Weights were taken for nonsalmonids as live weights aboard the vessels. In all cases, spring scales were used; scales may have changed calibration during their field use. Weights measured in such a way on a moving vessel can not be assumed to be as accurate as laboratory measurements with more precise scales.

Juvenile salmonids (total catch or subsamples of catches over 100 individuals) were preserved in buffered 10-percent formalin and held at least 3 days before they were measured for length and weight. This follows a standard FRI practice. Total catch weights and individual fish lengths, therefore, have live values for nonsalmonids and preserved values for salmonids.

Some data recording errors likely occurred in the rush to process fish between sets or in late evenings after sets were made. Computer data files were twice proofed against field records before acceptance.

Distance of tows or sets, as required by NOAA, could only be estimated given the scale of charts existent for most transects and given the low level of Loran C reliability. We made our best estimates with the information available. Tide height could not be predicted as tidal prediction tables did not correspond to real tidal conditions. The stage was estimated in all cases from the tidal prediction tables, which also have inherent errors.

Locations indicated by Loran C based on available charts were often substantially at variance with reality. The Loran C numbers were encoded as a station note in the NOAA-formatted information so that a future investigator could return to the sites sampled. With Loran C limitations, few radar fixes, and the outdated bathymetric charts, we made the best estimates possible of stations sampled in 1984.

All juvenile salmon or subsamples of any single species catch over 100 fish were preserved for final verification of species.

Finally, outside (Stations 1-5) versus inside (Stations 6-11) station comparisons must be tempered by the fact that, while meeting depth criteria, Stations 3 and 4 on Transect 4 (Port Moller) were at least partially inside the bay, depending on how the bay is defined. Similarly, outside beach seine stations (Station 5) on Transects 2 (Port Heiden), 4 and 6 (Izembek Lagoon) are not true open-coast stations. They sit inside or in the mouth of each bay, but they do face the open ocean (Appendix A). These are quite different from Station 5 occupied on Transects 1, 3, and 5, which are truly on open coast with no protection.

3.4.2 1985

Weather still dictated much of our 1985 activity, but not to the extreme experienced in 1984. Our coverage of transects and stations on transects was about what we anticipated could be accomplished in the 6-week period.

Data entry errors in 1985 were likely reduced by the much shorter time between sample collection and data entry into computer files. The change in sample station criteria between 1984 and 1985 complicates somewhat interpretation and comparison of data sets: Transects 2, 4, and 6 in 1984 are on the same Loran C line as in 1985, but Stations 2 and 3 are at different depths and locations from shore in these two years. In 1984, these two stations were depth-stratified, while in 1985 they were distance-stratified. Transect O was not sampled outside Ugashik Bay in 1984 due to weather problems.

3.5 ANALYSIS

In the laboratory problematic species, including all juvenile salmon, were identified or confirmed and field data sheets revised accordingly. Key-to-disk entry was used to enter and verify data on 5-inch diskettes using an IBM PC microcomputer. In 1984, this occurred post-field season, while in 1985 this data input was completed aboard the 55-foot vessel.

All data collected were coded, reformatted (EDS File Type 123), placed on 7-track magnetic tape, and sent to EDS/NODC with full documentation as part of the OCSEAP data base.

Catch in units of numbers caught for juvenile salmonids, and weight and numbers for nonsalmonids, was the standard method of determining the relative abundance of species captured by various types of sampling gear. A single set, standardized to a 10-minute opening time, was the unit of effort for both large and small purse seining. Based on area fished, a catch of 1 fish per set in the small seine would be the equivalent of a catch of approximately 2.5 fish per set in the large seine, assuming both nets fished the same population density. A 10-minute tow was the unit of effort for tow net and otter trawl. A single set with constant area/volume fished was the unit of effort for beach seine data. Catch data were reported in terms of CPUE by season, location, and gear type. Length-frequency graphs were plotted for important species by season to aid interpretation of fish movements and growth in the study area.

To facilitate a temporal evaluation of fish caught in offshore operations primarily with the large purse seine, Cruise 4 in 1985 was somewhat artificially divided into two 3-week periods labeled 4a and 4b. These two cruise segments in 1985 equal the approximate 3-week lengths of Cruises 1, 2, and 3 in 1984.

3.6 SOCKEYE SALMON SCALE PATTERN ANALYSIS

The abundance of juvenile salmon at a given space and time in their migration path is dependent on the relative abundances, initial dates of migration, distances traveled, and rates of travel of stocks contributing to the migration. Since there appears to be a defined space and time progression of Bristol Bay sockeye stocks through the NAS study area (Straty 1974; this report), periodic, short-term oil mishaps or chronic, but localized, development-related perturbations could differentially affect some stocks more than others. Bax (1985) concluded on the basis of computer simulations that the severity of oil spill impacts would vary according to spill timing and trajectory relative to the timing and abundance of salmon in the migration corridor.

We attempted to determine the stock-specific migratory timing of juvenile sockeye in the NAS study area by discriminant function analysis of scale growth patterns. The scales of salmonids have long been used to age individual fish, but recently scale growth patterns have been used to identify origins of salmon taken in commercial and research catches in non-terminal fishing areas. Experimental applications of scale pattern analysis for distinguishing stocks of Bristol Bay sockeye in mixed-stock catches of adults on the open ocean (Cook 1979) and within Bristol Bay (Krasnowski and Bethe 1978) have shown that scale growth patterns may be sufficiently distinct between stocks to allow a high degree of accuracy in stock classification.

Discriminant function analysis requires a set of training samples from all groups expected to be present in the samples to be analyzed. Accordingly, we obtained training samples of up to 200 smelt scales from among those collected by ADF&G at the outlets of each major Bristol Bay river system during the 1985 outmigration. Samples of scales from juvenile sockeye of unknown origin also were taken from fish captured at the Ugashik and Port Heiden transects in 1985 large purse seine catches. Samples from the Port Moller and Izembek Lagoon transects were not included in the analysis because catches generally were too small, and because of the likelihood that they were contaminated by local sockeye stocks for which training samples were not available.

The methodology employed in scale pattern analysis is widely documented (e.g., Conrad 1983; Rogers et al. 1984; Knutsen 1985; and others). Scales taken from the "preferred area" (Clutter and Whitesel 1956) or near it on the fish's body were mounted between microscope slides and projected 210X to an electronic digitizing tablet. After identifying scale annuli, measurements were taken along a standardized axis from scale focus to margin. The coordinates of the scale characters being measured were entered with a hand-held free-cursor and processed by a microcomputer interfaced to the digitizing tablet. Scale measurements (numbers of circuli and intercircular distances to 0.001 inch) were formatted and recorded, along with corresponding biological identifiers, on floppy diskettes.

These data were used to construct a linear discriminant function (LDF) by which the relative proportions of each stock present in purse seine catches at Ugashik and Port Heiden could be estimated. The LDF analysis available in the BMDP computerized analysis series (BMDP7M; Dixon and Brown 1979) evaluated training sample scale data to select a linear combination of scale characters showing greatest between-stock variation relative to within-stock variation. The accuracy of the resulting allocation rule was assessed by reclassifying each individual scale in the training samples against all others. The tallied results gave the classification accuracy of the LDF and the probability of misclassification, which were then used to adjust estimates of stock membership of unknown scales.

4.0 RESULTS

4.1 GENERAL

4.1.1 1984

The 1984 sampling season was completed between June 26 and September 12, 1984, and involved 277 sets of five gear types (large purse seine - PS, beach seine - BS, tow net - TN, otter trawl - OT, and beam trawl - BT) (Table 4a). As shown in Table 4a, some transects were not sampled during some cruises (i.e., Cruise l/Transects 1 and 6, Cruise 2/Transect 2). Effort was also low on some transects during some cruises (i.e., Cruise 3/Transect 5) due to weather interference. Transect O was a special case and was only sampled in Cruise 2.

All 1984 purse seine sets (71 total) were made at outside stations (l-3). For other gear types, the inside (Stations 6-11) versus outside (Stations 1-5) effort was 30 versus 17 beach seine sets, 18 versus 22 tow net hauls, and 27 versus 90 otter trawls, respectively. All effort on Transects 1, 3, and 5 was at outside stations since these transects lacked embayments. In all comparisons, the variability in sampling effort must be considered. Beam trawls were not further analyzed since only two 10-minute hauls were achieved without gear failure or bottom hangup.

An overview of all 1984 catches (unstandardized) from all cruises in total numbers of fish taken by species is presented in Table la. The ranking numbers in Table la (in parentheses) are the numerical rank of numbers caught by each gear type and for all gear types combined (last column) . A total of over 88,400 fish representing some 53 taxa was captured in all 1984 sampling. The scientific and common names of those species captured and identified to date are provided in Table 5 and include eight species not previously reported nearshore in the study area (Table 2).

TABLE 4a

1984 SAMPLING EFFORT BY GEAR, TRANSECT, STATION, AND CRUISE

STATION NUMBER	TRANSECT NUMBER 0 (UGASHIK) CRUISE I	II	III	1 CRUISE I	II	III	2 (*IIDEN) CRUISE I	II	III	3 CRUISE I	II	III	4 (MOLLER) CRUISE I	II	III	5 CRUISE I	II	III	6 (MOFFET) CRUISE I	II	III	TOTALS BY CRUISE I	II	III	GRAND TOTALS
Outside 1(27m)					PS-2				PS-2 OT-2		PS-2		PS-3	PS-2			PS-2			PS-2		PS-3	PS-9	PS-2 OT-2	PS-14 OT-12 (27m)
2(20m)					PS-2 OT-2	PS-2 OT-2	PS-2 OT-2		PS-2 OT-2	PS-2 OT-2	PS-2 OT-2	PS-2 OT-2	PS-2 OT-2 TN-2	PS-2 OT-2	PS-2 OT-2	PS-2 OT-2	PS-2 OT-2			PS-2 OT-2	PS-1 OT-2	PS-8 OT-8 TN-2	PS-10 OT-10	PS-9 OT-10	PS-27 OT-28 TN-2 (20m)
3(12m)					PS-2 OT-2 TN-2	PS-2 OT-2	PS-2 OT-2		PS-2 OT-2	PS-2 OT-2 TN-2	PS-2 OT-2 TN-2	PS-2 OT-2	PS-2 OT-2	PS-2 OT-2 TN-2	PS-2 OT-2	PS-2 OT-2	PS-2 OT-2	PS-2 OT-2		PS-2 OT-2	PS-2 OT-2	PS-8 OT-8 TN-2	PS-10 OT-10 TN-6	PS-12 OT-12	PS-30 OT-30 TN-8 (12m)
4(6m)					OT-2 TN-2 BT-1	OT-2	OT-2		OT-2	OT-2 TN-2	OT-2 TN-2	OT-2	OT-2 TN-2 BT-1	OT-2 TN-2	OT-2 TN-2	OT-2	OT-2	OT-2		OT-2	oT-2	OT-8 TN-4 BT-1	OT-10 TN-6 BT-1	OT-12 TN-2	OT-30 TN-12 BT-2 (6m)
5(Beach					0S-2					BS-2		BS-1	BS-2	BS-4	BS-2					BS-2	BS-2	BS-4	0s-8	BS-5	BS-17 (Out-side Beach)
Inside 6		BS-2					BS-2						0S-2	BS-2	BS-3					BS-3	BS-3	0S-4	BS-9	BS-6	BS-19
7		BS-2											OT-2 TN-2	OT-2 TN-2	OT-2 TN-2					OT-2	OT-2 TN-2	OT-2 TN-2	BS-2 OT-4 TN-2	OT-4 TN-4	BS-2 OT-10 TN-8
8		TN-2											BS-1							OT-2 TN-2	OT-2	BS-I	OT-2 TN-4	OT-2	BS-1 OT-4 TN-4
9													BS-1		BS-2					OT-2	oT-2	0S-1	OT-2	BS-2 OT-2	0S-3 OT-4
10													OT-1	OT-2 TN-2	OT-2					BS-3		OT-I	BS-3 OT-2 TN-2	OT-2	BS-3 OT-5 TN-2
11													OT-2 TN-2	OT-2 TN-2						0s-2		OT-2 TN-2	0S-2 OT-2 TN-2		BS-2 oT-4 TN-4
TOTALS		0S-4 TN-2			PS-6 BS-2 OT-6 TN-4 BT-1	PS-4 OT-6	PS-4 BS-2 OT-6		PS-6 OT-8	PS-4 0S-2 OT-6 TN-4	PS-6 OT-6 TN-4	PS-4 BS-1 OT-6	PS-7 BS-6 OT-11 TN-B BT-1	PS-6 BS-8 OT-12 TN-10	PS-4 BS-7 OT-10 TN-4	PS-4 OT-6	PS-5 OT-6	PS-2 OT-4		PS-6 BS-10 OT-12 TN-2	PS-3 0S-5 OT-12 TN-2	PS-19 BS-10 OT-27 TN-12 BT-1	PS-29 0S-24 OT-42 TN-22 BT-1	PS-23 BS-13 OT-46 TN-6	
GRAND TOTALS		BS-4 TN-2			PS-10 0S-2 OT-12 TN-4 BT-1			PS-10 BS-2 OT-14			PS-14 BS-3 OT-18 TN-B			Ps-17 BS-21 OT-33 TN-22			PS-11 OT-16			PS-9 0S-15 OT-24 TN-4					PS-71 0s-47 OT-117 TN-40 BT-2

1/ Gear Codes: PS-Purse seine BS-Beach seine OT-Otter trawl TN-Tow net BT-Beam trawl

TABLE 4b

1985 SAMPLING EFFORT BY GEAR, TRANSECT, STATION, AND CRUISE

STATION NUMBER	TRANSECT NUMBER 0 (UGASHIK) CRUISE I	II	2 (HEIDEN) CRUISE I	II	4 (MOLLER) CRUISE I	II	6 (MOFFET) CRUISE I	II	TOTALS BY CRUISE I	II	GRAND TOTAL
0(15m)	PS-3	PS-!	PS-1	PS-5	PS-3	PS-	PS-2	PS-:	PS-9	PS-1	PS-2?
1(10m)	PS-3	PS-!	PS-1	PS-5	PS-4	PS-2	PS-2	PS-:	PS-1?	PS-1	PS-24
2(5m)	PS-3	PS-1?	PS-2	PS-5	PS-4	PS-3	PS-2	PS-:	PS-1?	PS-2	PS-31
3(12m)			PS-2 SS-3	PS-5	PS-5 SS-2	PS-4	PS-2	PS-:	PS-9 3s-5	PS-1	PS-20 SS-5
4(Beach at o only)		3S-2	SS-2	SS-1	SS-2	55-4			5s-4	8s-2 55-5	SS-9 0S-2
5(Beach		BS-3		BS-3	BS-3	3S-5			3s-3	3s-1	3s-14
Inside (Beach				BS-3	8s-5	BS-5		BS-:	3S-5	BS-1?	BS-15
7		BS-2			55-3	SS-4		8s-2	SS-3	SS-4 BS-4	5$-7 BS-4
8		?S-1			BS-1	BS-2			IS-1	SS-1 BS-2	55-I BS-3
9		?S-1			BS-1	BS-2			S-I	SS-1 BS-2	?S-1 3S-3
10		?S-1						SS-2			is-3
11								SS-1		S-I	55.-1
12					SS-1	5S-2			S-I	55-2	?S-3
13					5s-1	?S-3			S-1	?S-3	SS-4
TOTALS	PS-9	'S-20 S-3 S-7	PS-6 55-5	's-20 ?S-1 ?S-6	PS-16 5s-9 3S-10	?S-1? ?S-1? IS-14	PS-8	PS-8 SS-3 8s-4	's-39 S-14 s-lo	?S-5? ?S-2? ?S-3?	
GRAND TOTALS	PS-29 SS-3 BS-7		PS-26 SS-6 8s-6		PS-26 PS-22 BS-24		PS-16 s s-3 8S-4				%-9 7 5S-34 35-4 I

1/ Gear Codes: PS-Purse seine SS-Small seine BS-Beach seine

TABLE 5

COMMON AND SCIENTIFIC NAMES OF IDENTIFIED FISH TAXA
NORTH ALASKA PENINSULA, 1984-1985 (WITH NOAA TAXONOMIC CODE)[a]

NODC Taxon Code	Common Name	Scientific Name
8857041501	Alaska Plaice	Pleuronectes quadrituberculatus
8791030201	Arctic Cod	Boreogadus saida
8857041001	Arctic Flounder	Liopsetta glacialis
8603010201	Arctic Lamprey	Lampetra iaponica
8831080901	Bering Poacher	Occella dodecaedron
8831022101	Brightbelly Sculpin	Microcottus sellaris
8857040701	Butter Sole	Isopsetta isolepis
8755030201	Capelin	Mallotus villosus
8755010206	Chinook Salmon	Oncorhynchus tshawytscha
8755010202	Chum Salmon	Oncorhynchus keta
8791030000	Cods (unid.)	Gadidae
8755010203	Coho Salmon	Oncorhynchus kisutch
8842130205	Crescent Gunnel	Pholis laeta
8831020601	Crested Sculpin[b]	Blepsias bilobus
8755010401	Dolly Varden	Salvelinus malma
8755030501	Eulachon	Thaleichthys pacificus
8857040000	Flounder (unid.)	Pleuronectidae
8857040601	Flathead Sole	Hippoglossoides elassodon
8831022204	Great Sculpin	Myoxocephalus polyacanthocephalus
8827010101	Kelp Greenling[b]	Hexagramnos decagrammus
8857040902	Longhead Dab	Limanda proboscidea
8818010201	Ninespine Sticklebacks	Pungitius pungitius
8791030401	Pacific Cod	Gadus macrocephalus
8857041901	Pacific Halibut	Hippoglossus stenolepis
8747010201	Pacific Herring	Clupea harengus pallasi
8840010201	Pacific Sandfish	Trichodon trichodon
8845010101	Pacific Sand Lance	Ammodytes hexapterus
8831021801	Pacific Staghorn Sculpin	Leptocottus armatus
8831020401	Padded Sculpin	Artedius creaseri
8755010201	Pink Salmon	Oncorhynchus gorbuscha
8831022201	Plain Sculpin	Myoxocephalus jaok
8755030102	Pond Smelt[b]	Hypomesus olidus
8755030302	Rainbow Smelt	Osmerus mordax
8831023805	Ribbed Sculpin	Triglops pingeli
8857040801	Rock Sole	Lepidopsetta bilineata
8842130206	Saddleback Gunnel[b,d]	Pholis ornata
8831022301	Sailfin Sculpin[b]	Nautichthys oculofasciatus
8831020000	Sculpin (unid.)	Cottidae

TABLE 5 (Cont.)

NODC Taxon Code	Common Name	Scientific Name
8831020602	Silverspotted Sculpin	Blepsias cirrhosus
8755030000	Smelt (unid.)	Osmeridae
8831090000	Snailfish (unid.)	Liparis sp.
8842120902	Snake Prickleback	Lumpenus sagitta
8755010205	Sockeye Salmon	Oncorhynchus nerka
8857041401	Starry Flounder	Platichthys stellatus
8831080802	Sturgeon Poacher	Agonus acipenserinus
8755030101	Surf Smelt	Hypomesus pretiosus
8831021603	Threaded Sculpin[b]	Gymnocanthus pistilliger[c]
8818010101	Threespine Sticklebacks	Gasterosteus aculeatus
8831022401	Tidepool Sculpin[b]	Oligocottus maculosus
8831081101	Tubenose Poacher	Pallasina barbata
8791030701	Walleye Pollock	Theragra chalcogramma
8827010104	Whitespotted Greenling	Hexagrammos stelleri
8842020201	Wolf-eel[b]	Anarrhichthys ocellatus
8857040901	Yellowfin Sole	Limanda aspera

[a]Source: AFS, 1980, except as noted
[b]Not previously reported in the area, Table 2
[c]Wilimovsky 1958
[d]Taken only in 1985

Length-frequency evaluations were completed on those species where sufficient individuals were captured and measured in each of the three cruises.

A breakdown of 1984 catches by cruise, transect, and station for purse seine, tow net, beach seine, and otter trawl is provided in Appendices B through E, respectively. Species evaluations for 1984 that follow are divided into juvenile salmonids (Section 4.2) and non-salmonids (Section 4.5). Adult salmonids taken in 1984 (Table la) are not discussed further since sampling gear was not scaled to a size adequate to consistently sample adults.

4.1.2 1985

The 1985 sampling season was completed between June 16 and July 28, 1985, and involved 172 sets of three gear types (large purse seine - PS, small purse seine - SS, and beach seine - BS) as summarized in Table 4b (p. 74). To facilitate temporal assessment of the Cruise 4 data in 1985, the sampling season was divided into two subsets (4a and 4b). Cruise 4a ended on July 6 and Cruise 4b began on July 7, providing 3 weeks in each subsampling period. This division of Cruise 4 was made primarily for the large purse seine. For continuity of comparisons in 1985, the same dividing date was used for the small seine and the beach seine, even though these two' gear types were initiated later in Cruise 4a than the large seine effort. Therefore, while this Cruise 4 division is fairly even for the large seine effort, there was less beach seine and small seine effort in Cruise 4a than Cruise 4b.

Of the 34 small seine sets made in 1985, 14 were made in outside locations and the remaining 20 sets were made in inside locations (Stations 7-13). Of the 41 beach seine sets, only 16 sets were made at outside locations (generally exposed to the open ocean) while the remaining 25 sets were made at the inside stations (6-9).

An overview of all catches (unstandardized) for all gear types in 1985, in terms of total numbers of fish taken by species, is presented in Table lb. As in 1984, a numerical ranking of numbers caught by each gear type and by all gear types combined (last column) is shown in parentheses. A total of almost 30,000 fish representing some 30 identified taxa (Table 5) was captured in 1985. A single new species, the saddleback gunnel, *Pholis ornata,* was taken in 1985. This species joins the eight taken in 1984 that were not previously reported (Table 2) in the area. The total number of species taken in 1985 declined from the 53 taken in 1984 primarily due to dropping the otter trawl in the 1985 study .

In 1985, juvenile salmon (chinook, chum, coho, pink, and sockeye) made up 52 percent by number of fish taken (Table lb). If the catches of two other pelagic species, Pacific sand lance and rainbow smelt, are combined with juvenile salmon, together they constitute 93 percent of the total 1985 catch.

Unlike the 1984 effort with the tow net targeting on pelagic species, the small purse seine proved more successful in capturing pelagic fish in nearshore and inside waters. As with the large seine operation in 1984, weather and tidal current direction dictated, to some degree, the small seine sampling capability in 1985. This was due to the use of an inflatable boat as a skiff.

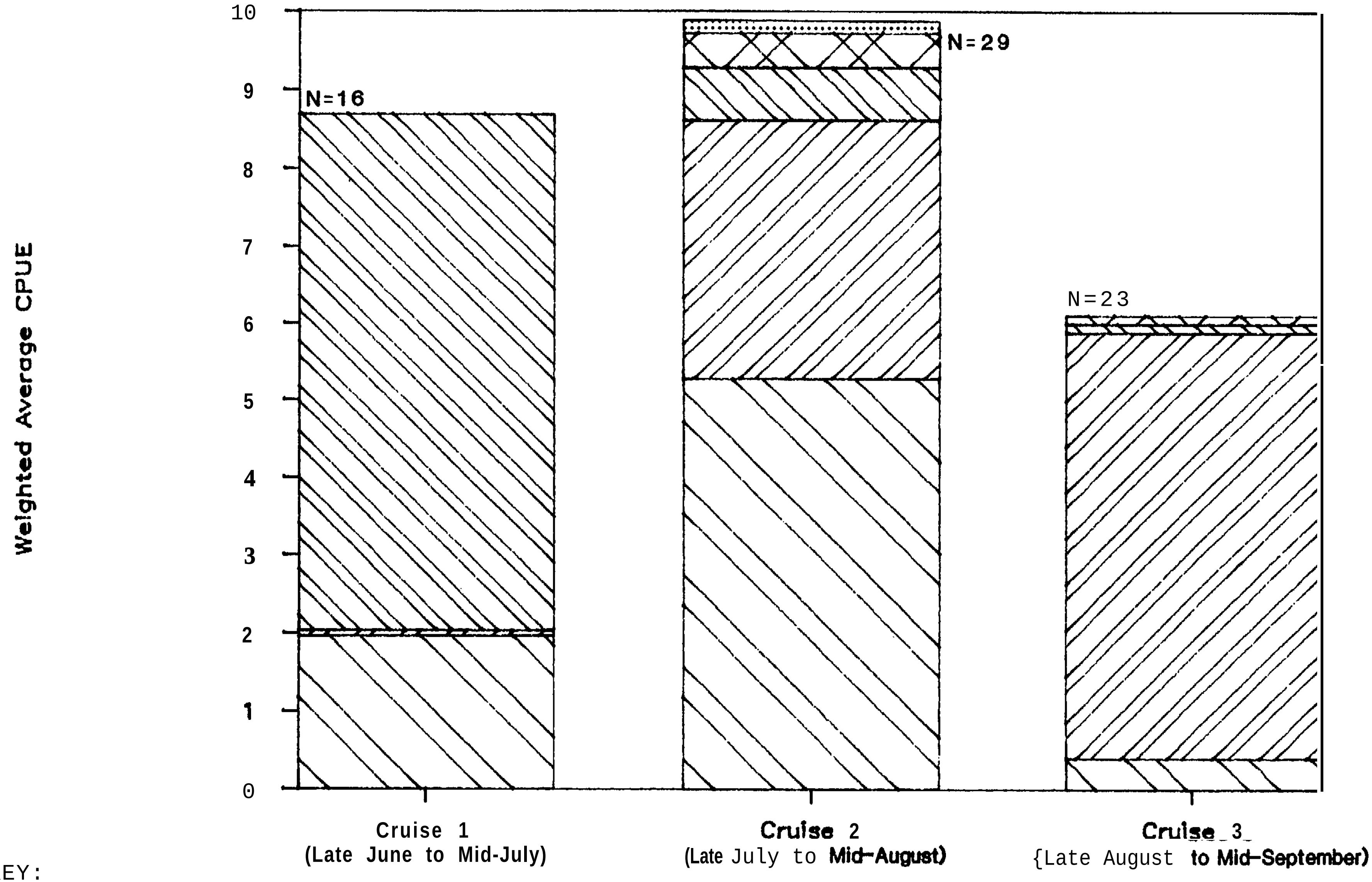
Statistical summaries of 1985 catches by cruise, transect, station, and gear are provided in Appendices G through I, respectively. Evaluations for 1985 that follow are divided into 1985 salmonids results (Section 4.3), a general discussion of juvenile salmonid distributions and movements (Section 4.4), 1985 nonsalmonids (Section 4.6), and comparisons of 1984 and 1985 catch data (Section 4.7).

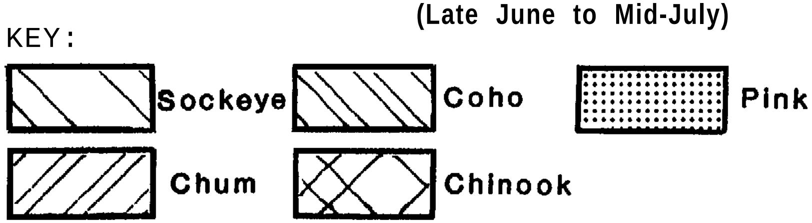
4.2 SALMONIDS - 1984

4.2.1 General Catch Patterns

The total raw catch of juvenile salmon across all gear types in 1984 was 898, or about 1 percent of all fish captured. Of this figure, 771 (86 percent) were captured in the purse seine, 84 (9 percent) in the beach seine and 43 (5 percent) in the tow net (Table la).

The purse seine CPUE of all juvenile salmon (all species, stations, and transects combined), was only 8.21 fish per set (weighted average, standardized for 10-minute set time). Purse seine CPUE was slightly greater in Cruise 2 (late July to mid-August; 9.86) than in Cruise 1 (late June to mid-July; 8.60) and dropped significantly by Cruise 3 (late August to mid-September; 5.82) (Figure 8; Table 6). This pattern is compared to the seasonal patterns of abundance of other major species caught by the purse seine in Figure 9. A comparison of the purse seine CPUE by subarea, summed over all cruises, showed a decreasing catch rate from the inner (Transects 1 and 2, 15.7 fish per set) to the middle (Transects 3 and 4, 8.2 fish per set) and outer bay (Transects 5 and 6, 0.7 fish per set) subareas (Figures 9 and 10).





1984 Purse Seine Catch of Juvenile Salmon by Cruise
(all transects and stations combined)

Dames & Moore

Figure 8

TABLE 6

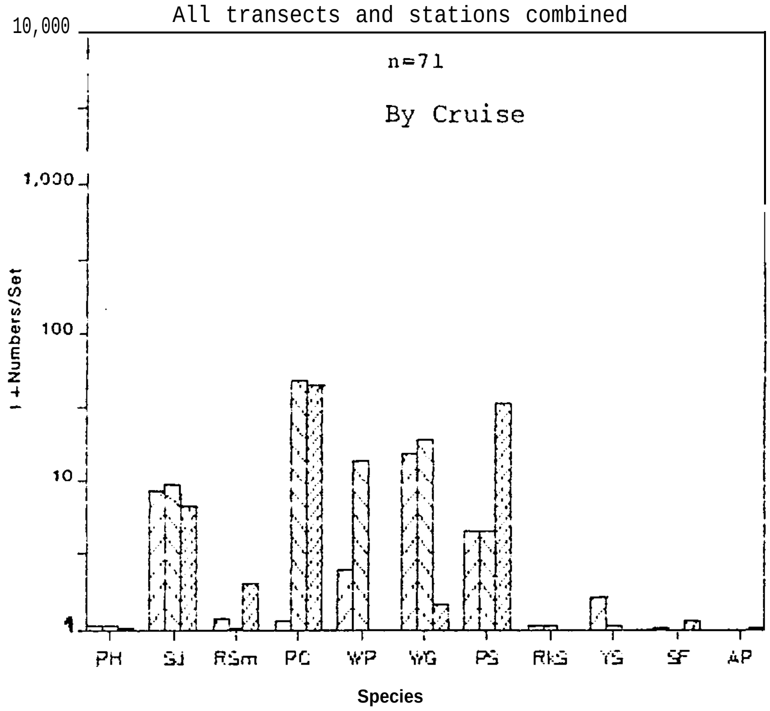
1984 PURSE SEINE CATCH FOR ALL JUVENILE SALMONIDS COMBINED[a]

Cruise	1				2				3				All Cruises			
Station	1	2	3	Wtd Avg	1	2	3	Wtd Avg	1	2	3	Wtd Avg	1	2	3	Wtd Avg
Transect:																
1					31.70	0.00	0.80	10.83		0.40	53.70	27.05	31.70	0.20	27.25	17.32
2		0.00	63.30	31.65					2.10	2.10	2.90	2.37	2.10	1.0S	33.10	14.08
3		4.40	0.00	2.20	60.00	26.70	9.60	32.10		1.20	1.20	1.20	60.00	10.77	3.60	14.73
4	1.20	4.60	6.50	3.69	2.90	0.80	4.40	2.70		0.50	2.80	1.65	1.88	1.97	4.57	2.86
S		0.30	0.80	0.55	0.00	0.00	2.10	0.84			0.00	0.00	0.00	0.15	0.97	0.58
6					0.00	0.40	3.60	1.33		0.00	0.00	0.00	0.00	0.27	1.80	0.89
Weighted Averages:																
Station	1.20	2.33	17.65		21.02	5:58	4.10		2.10	0.93	10.10	All Trans	14.07	3.07	10.11	
Cruise				8.60				9.86				5.82	All Cruise Weighted Average			8.21

[a]Weighted averages of station means, standardized to 10-minute set times. Cruise 1: Late June to mid-July; Cruise 2: Late July to mid-August; Cruise 3: Late August to mid-September.

Purse Seine, Cruise 1,2,3

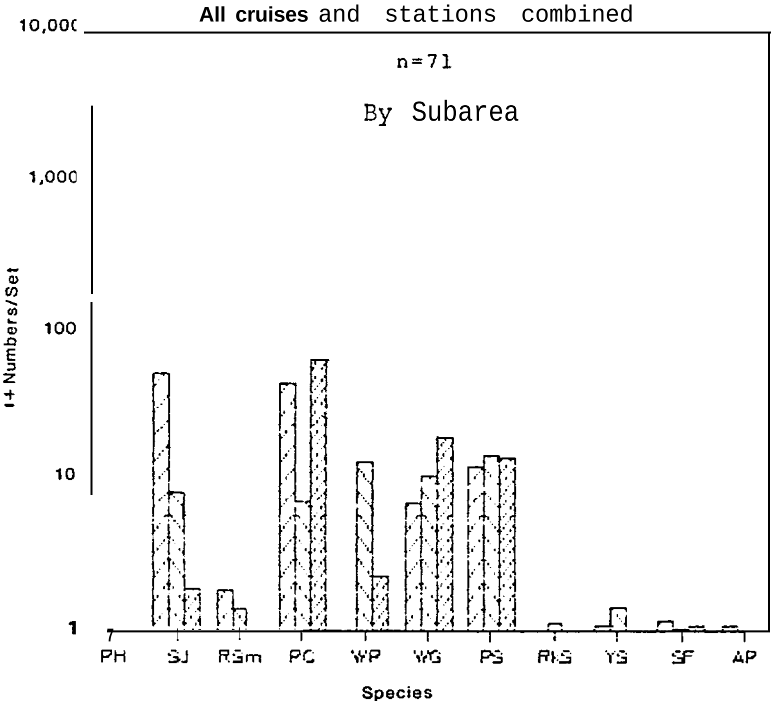
All transects and stations combined



Code:
Cruise
1 - (Late June to Mid-July)
2 - (Late July to Mid-August)
3 - (Late August to Mid-September)

Purse Seine: Inner, Mid, Outer Areas

All cruises and stations combined



Code:
Bay Subarea
Inner - (Tr 1&2)
Mid - (Tr 3&4)
Outer - (Tr 5&6)

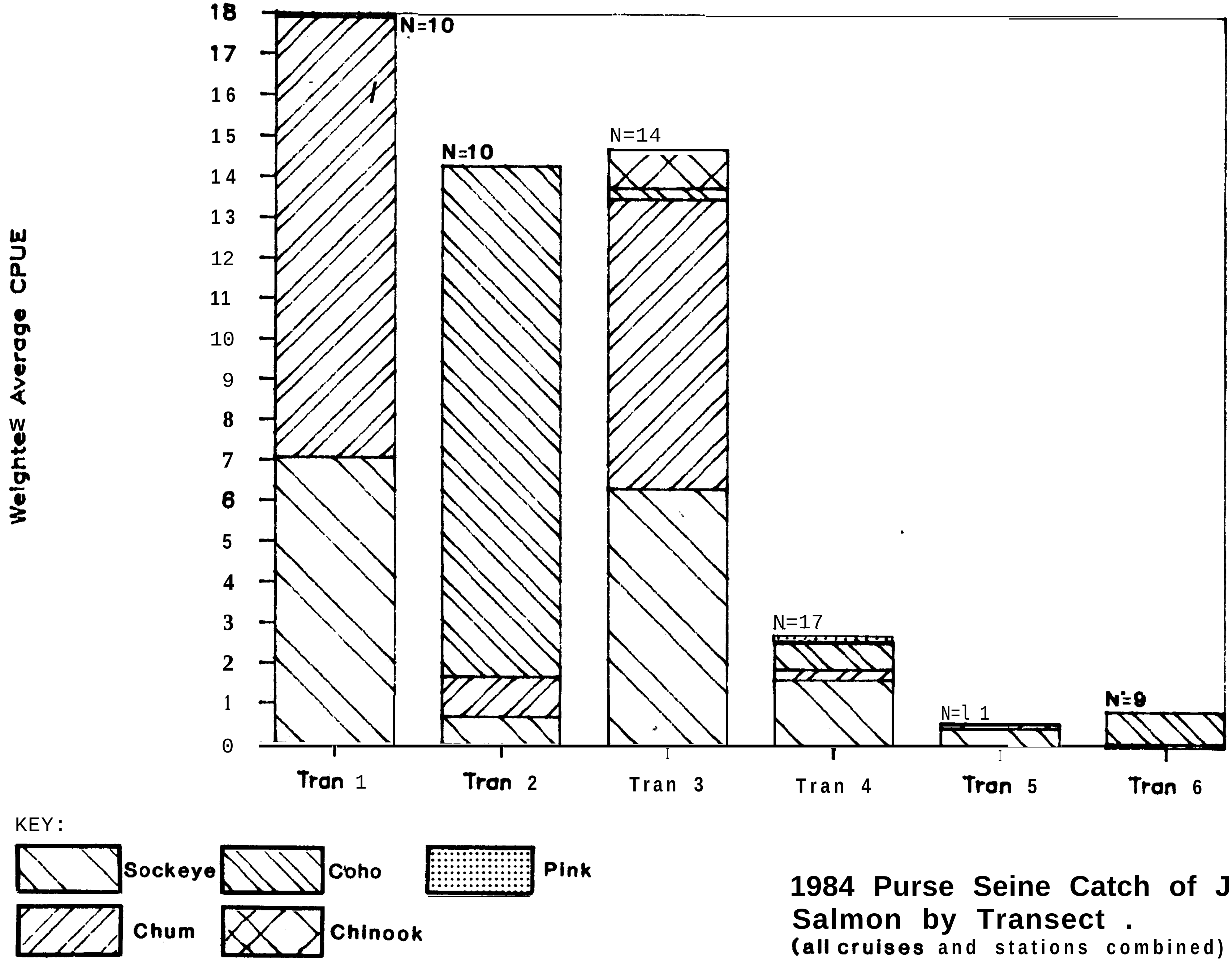
Species Code:
PH-Pacific herring
SJ-Salmon juveniles
RSm-Rainbow smelt
PC-Pacific cod
WG-Whitespotted greenling
PS-Pacific sandlance
RkS-Rock sole
YS-Yellowfin sole
SF-Starry flounder
AP-Alaska plaice

Catch of Important Fish Species by Cruise (top)

and by Subarea (bottom) with Purse Seine, 1984

Dames&Moore

Figure 9



1984 Purse Seine Catch of Juvenile Salmon by Transect.
(all cruises and stations combined)

Dames & Moore

Figure 10

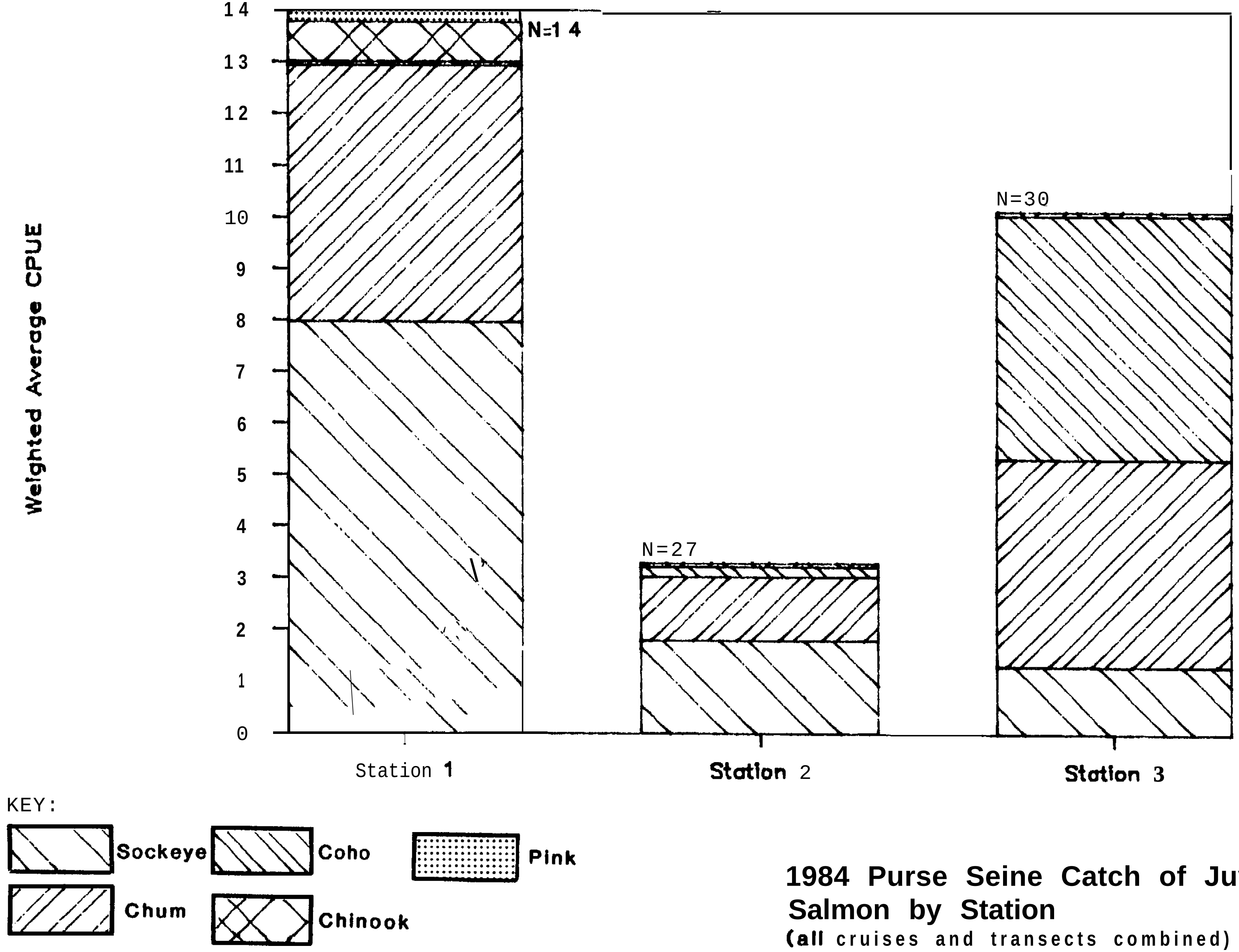
A comparison of CPUE by stations, all transects and cruises combined, indicated that Stations 1 and 3 (27 m and 12 m) had higher average catch rates than did the intermediate Station 2 (20 m) (Figure 11). This assertion is confounded by differences in sampling effort, since over twice as many sets were made at Stations 2 and 3 as at Station 1, and several large catches at Station 1 heavily influenced the data set. During Cruise 2 (late July to mid-August), where we had the most balanced effort (sampled all three stations on five transects), there was a sharp decrease in catch rate from Station 1 (21.0 fish per set) to Stations 2 (5.6 fish per set) and 3 (4.1 fish per set; Table 6) suggesting a preference for offshore vs. onshore habitats.

In Cruise 1, purse seine sampling was conducted on four days (June 29, July 1, 3, and 15). Transect 4 was sampled first, followed in order by Transects 3, 2, and 5. We made 19 hauls,of which 4 were empty sets and 11 (58 percent) caught juvenile salmonids. Catches ranged from O to 162 with a total raw catch of 221 and a mean standardized catch of 8.60 per set. As mentioned earlier, weather was a problem and prevented sampling on Transects 1 and 6 (Table 4).

In Cruise 2, purse seine sampling was conducted on six days (July 27, August 2, 3, 5, 10 and 12). Sampling began at Transect 1 followed by Transects 3, 5, 6, and 4. We made 29 hauls,of which none were empty sets and 15 (48 percent) caught juvenile salmonids. Catches ranged from O to 97 with a total raw catch of 382 and a standardized mean catch of 9.86 per set. Inclement weather prevented any sampling on Transect 2.

In Cruise 3, purse seine sampling was conducted on five days (September 2, 4, 8, 11, and 12). Sampling began at Transect 5 and progressed to Transects 6, 4, 3, 2, and 1. A total of 23 sets was made of which there were no empty sets and 16 of 23 (70 percent) caught juvenile salmonids. Catches ranged from O to 103 with a total raw catch of 168 and standardized mean catch of 5.82 per set. Coverage was good except for Transect 5 where only two sets were made.

84



1984 Purse Seine Catch of Juvenile Salmon by Station
(all cruises and transects combined)

Figure 11

Dames & Moore

Tow net catches of juvenile salmonids were significant only on Cruise 2 (Figures 12 and 13; Appendix C). The majority of the tow net catch (71 percent) was from a station inside Ugashik Bay with a very few additional fish taken offshore on Transect 3, inside Port Moller, and inside Izembek Lagoon. Because of this low success rate, tow netting was de-emphasized in Cruise 3 (Table 4a).

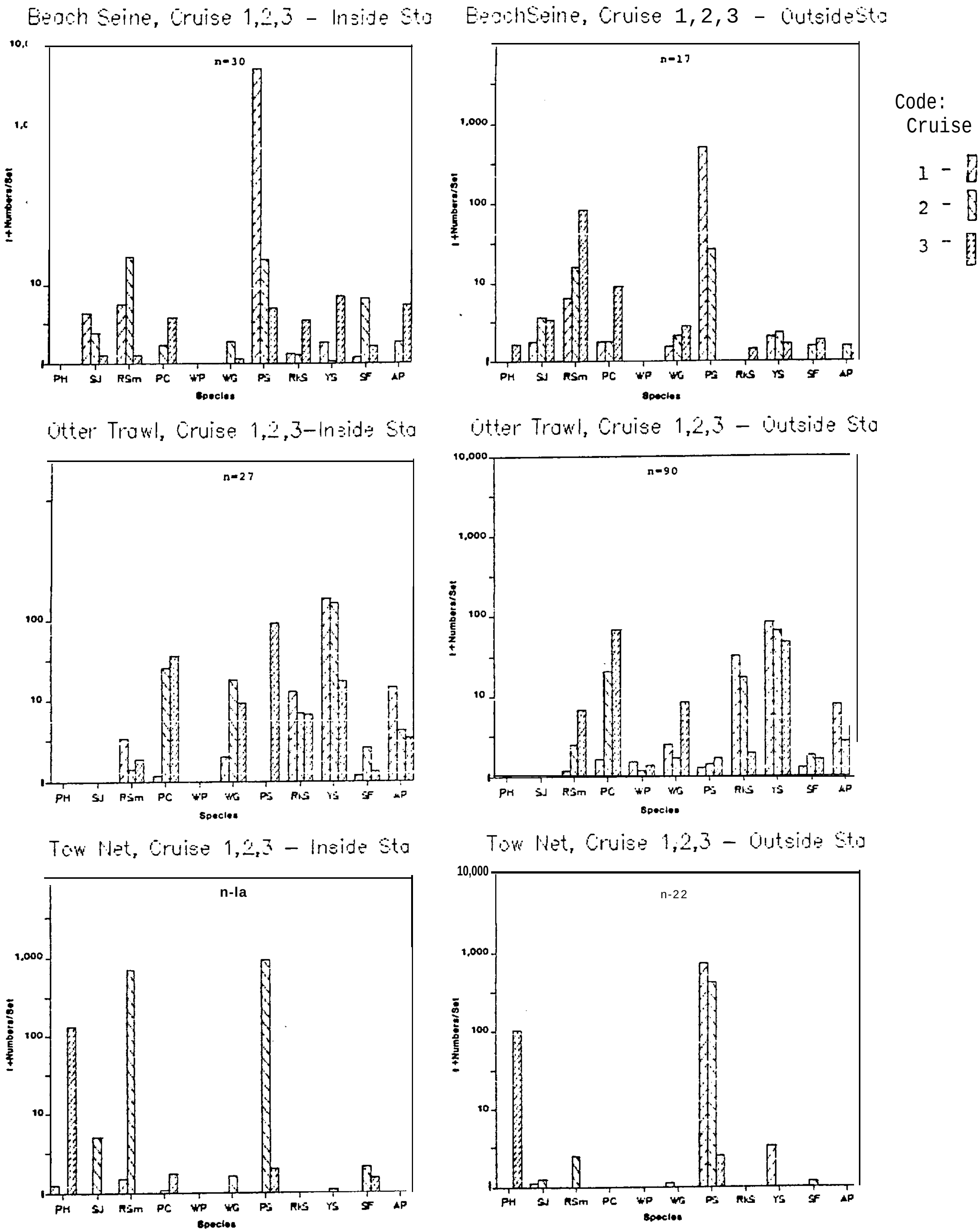
Mean beach seine catches of juvenile salmonids generally decreased at protected stations through the sampling season but were greater in Cruises 2 and 3 on unprotected beaches (Figures 12 and 13; Appendix D). Of protected beaches, Port Moller stations had a higher average catch rate than other embayments, while on exposed beaches Transect 6 had the greatest catches (sampled Cruises 2 and 3 only). However, the “exposed” Transect 6 beach seine site is somewhat protected (see Appendix A, Figure A-4).

4.2.2 Sockeye Salmon

Juvenile sockeye salmon (Oncorhynchus nerka) were expected to be an overwhelming dominant in our catches based on the many millions of smelts known to leave Bristol Bay spawning systems each spring. Average purse seine catch (standardized to 10-minute sets) over the entire sampling season was only 2.8 fish per set (Table 7). In Cruise 1 (late June to mid-July) purse seine catches, sockeye were the most frequently caught juvenile, occurring in 8 of 19 sets. Highest mean catches (6.1 fish per set) were from stations outside Port Moller (Transect 4) and at Transect 3. In Cruise 2 (late July to mid-August), much higher catches, to 31.7 per set, were taken off Transects 1 and 3 (Transect 2 not sampled). Highest catches (all transects combined) were at Station 1 (11.6 fish per set; n = 9) with progressively fewer fish per set nearer shore at Stations 2 and 3 (3.0 and 1.8 per set, respectively). Very few sockeye juveniles were taken at outer bay Transects 4 through 6. By early September (Cruise 3), juvenile sockeye were taken only off Transects 1 and 2 (2.5 fish maximum standardized catch in any set).

Juvenile sockeye occurred in only two beach seine hauls during Cruise 1, both inside Port Moller. In Cruise 2 beach seines, sockeye

Inside Stations (6-1 1) | **Outside Stations (l-5)**

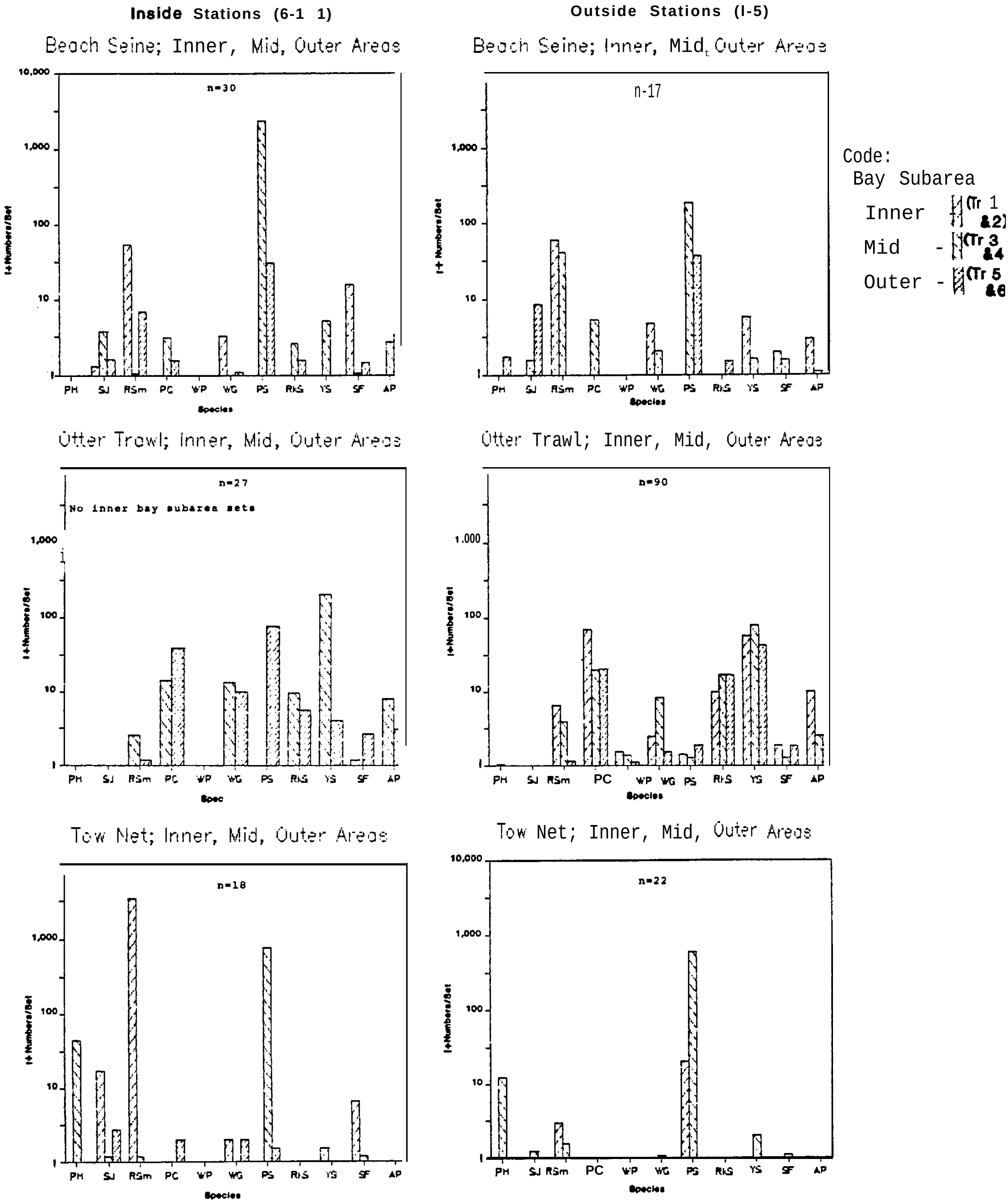


Species Code: PH-Paci f ic herring SJ-Salmon juveniles RSm-Rainbow smelt PC-Pacific cod WG-Whitespotted greenling PS-Pacific Sandlance RkS-Rock sole YS-Yellowfin sole SF-Starry flounder AP-Alaska plaice

Catch of Important Fish Species by Cruise with Beach Seine, Otter Trawl, and Tow Net, 1984 (all transects combined)

Dames & **Moore**

Figure 12



Species Code:
PH-Pacific herring
SJ-Salmon juveniles
RSm-Rainbow smelt
PC-Pacific cod
WG-Whitespotted greenling
PS-Pacific Sandlance
RkS-Rock sole
YS-Yellowfin sole
SF-Starry flounder
AP-Alaska plaice

Catch of Important Fish Species by Inner, Mid, and Outer Bay Subareas with Beach Seine, Otter Trawl, and Tow Net, 1984 (all cruises combined)

Dames & Moore

Figure 13

TABLE 7

1984 PURSE SEINE CATCH FOR JUVENILE SOCKEYE[a]

Cruise	1				2				3				All Cruises			
Station	1	2	3	Wtd Avg	1	2	3	Wtd Avg	1	2	3	Wtd Avg	1	2	3	Wtd Avg
Transect:																
1					31.70	0.00	0.80	10.83		0.40	2.50	1.45	31.70	0.20	1.65	7.08
2		0.00	1.70	0.85					1.70	0.00	0.00	0.57	1.70	0.00	0.85	0.68
3		4.40	0.00	2.20	19.90	14.00	6.00	13.30		0.00	0.00	0.00	19.90	6.13	2.00	6.33
4	1.20	4.30	6.10	3.49	0.80	0.80	0.00	0.53		0.00	0.00	0.00	1.04	1.70	2.03	1.62
5		0.00	0.40	0.20	0.00	0.00	2.10	0.84			0.00	0.00	0.00	0.00	0.83	0.45
6					0.00	0.40	0.00	0.13		0.00	0.00	0.00	0.00	0.27	0.00	0.09
Weighted Averages:																
Station	1.20	2.18	2.05		11.64	3.04	1.78		1.70	0.09	0.42		All Trane 7.99	1.80	1.31	
Cruise				1.97				5.28				0.40	All Cruise Weighted Average			2.81

[a] weighted averages of station means, standardi zed to 10-minute set times.

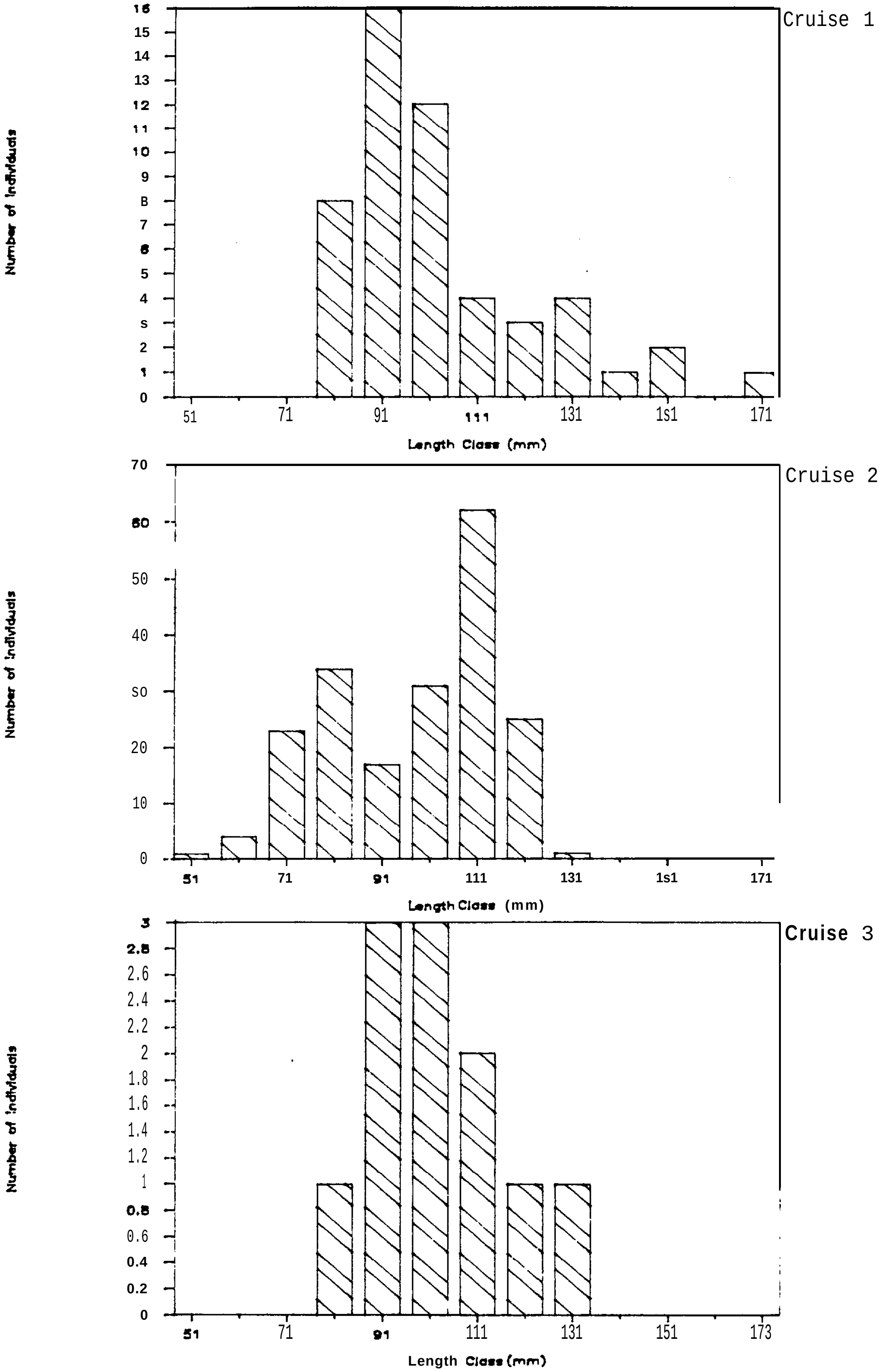
juveniles were taken in 7 of 24 sets on Transects 0, 1, 4 and 6 with peak catches (7 per set; n = 2) at Station 5, Transect 6, just inside the north entrance to Izembek Lagoon. Sockeye were also taken in tow nets (3.5 per set; n = 2) at Station 8 inside Izembek Lagoon during Cruise 2.

Sockeye juveniles were weakly bimodal in size during Cruise 1 with peaks at 91 to 100 mm (larger "l-check" outmigrants) and 131 to 140 mm (larger "2-check" outmigrants; Figure 14). In Cruise 2, sockeye size was strongly bimodal with peaks at 81 to 91 mm (smaller "l-check" outmigrants) and 111 to 120 mm (smaller "2-check" outmigrants). By Cruise 3, too few fish were measured to reveal size distribution patterns.

4.2.3 Chum Salmon

Chum salmon (*O. keta*) juveniles were taken in only two purse seine sets (one fish each) during Cruise 1 (late June to mid-July), both on Transect 5. During Cruise 2 (late July to mid-August), chum juveniles were only taken on Transect 3 where they were relatively abundant, ranging from 34.3 per set at the offshore Station 1 to 3.6 per set at the inner Station 3 (Table 8). During Cruise 3 (late August to mid-September), juvenile chums were surprisingly abundant in purse seine sets from Transect 4 north into the bay. Chum juveniles were caught in 72 percent (13 of 18 sets) of sets in this region with catches up to 50.8 fish (standardized) in two sets at Station 3 (n-m), Transect 1 on the last day of sampling. Only five chum juveniles were taken in beach seining in Cruise 1 (Transects 3 and 4) and none were taken in Cruise 3. During Cruise 2, scattered chum juveniles were taken in beach seines at Transects 4 and 6. No chum juveniles were taken in tow netting in Cruise 1 or 3, however, during Cruise 2, they were common (15 per set; n = 2) in catches inside Ugashik Bay (Transect 0).

Juvenile chum salmon spanned a wide range of sizes in Cruises 2 and 3 (Figure 15) with a significant increase in the size of the dominant mode between the two sampling periods.



Length-Frequency of Sockeye Salmon in Purse Seines, 1984
(all transects and stations combined)

Dames & Moore

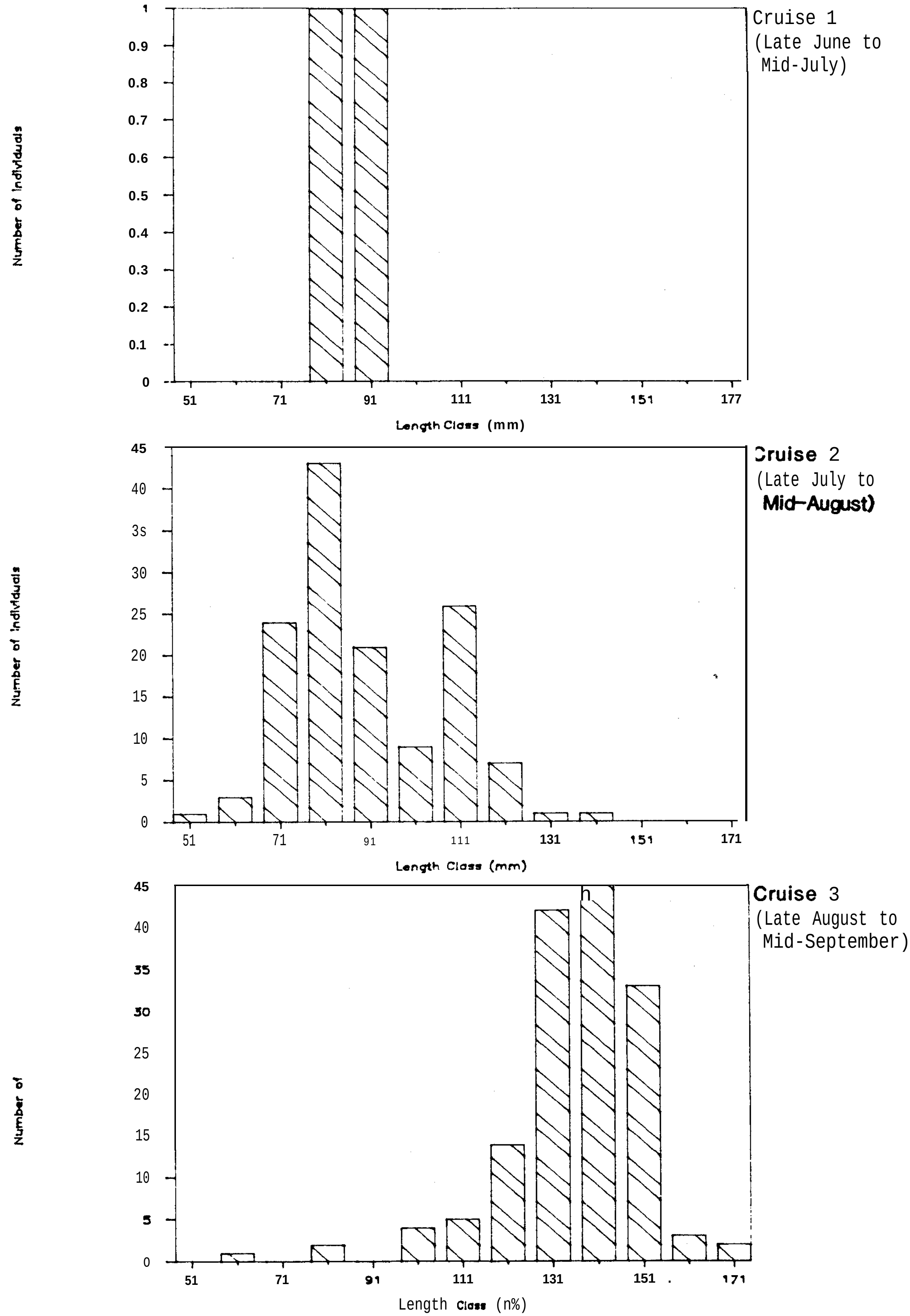
Figure 14

TABLE 8

1984 PURSE SEINE CATCH FOR JUVENILE CHUM[a]

Cruise	1				2				3				All Cruises			
Station	1	2	3	Wtd Avg	1	2	3	Wtd Avg	1	2	3	Wtd Avg	1	2	3	Wtd Avg
Transect:																
1					0.00	0.00	0.00	0.00		3.40	50.80	27.10	0.00	1.70	25.40	10.84
2		0.00	0.00	0.00					0.40	1.70	2.90	1.67	0.40	0.85	1.45	1.00
3		0.00	0.00	0.00	34.30	10.50	3.60	16.13		0.80	0.80	0.80	34.30	3.77	1,47	7.14
4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	2.30	1.15	0.00	0.00	0.77	0.27
5		0.30	0.40	0.35	0.00	0.00	0.00	0.00			0.00	0.00	0.00	0.15	0.13	0.13
6					0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00
Weighted Averages:																
Station	0.00	0.08	0.10		7.62	2.10	0.72		0.40	1.31	9.47		All Trans 4.96	1.24	4.05	
Cruise				0.07				3.34				5.49	All Cruise Weighted Average			3.16

[a] Weighted averages of station means, standardized to lo-minute set times.



Length-Frequency of Chum Salmon in Purse Seines, 1984
(all transects and stations combined)

Dames & Moore

Figure 15

4.2.4 Coho Salmon

Surprisingly, coho (silver) salmon (*O. kisutch*) provided the largest mean standardized purse seine capture of juvenile salmonids in 1984: 62.6 fish in two July 3 (Cruise 1) sets on Station 3 of Transect 2 (Table 9). Apart from this station, a few juvenile coho occurred in scattered sets on Transects 2 and 3 (Cruise 3) Transect 4 (all cruises) and Transect 6, Station 3 (Cruise 2). Coho were the most common salmon juvenile caught in beach seines on Cruise 1 (Shingle Point, Herendeen Bay) and were the only juvenile salmon caught in Cruise 3 beach seines (Transect 4, Station 5 and Transect 6, Stations 5 and 6). The three juvenile coho in Cruise 2 beach seines all came from Transect 6, Stations 5 and 11. Coho juveniles were not taken in tow net sampling in any cruises.

4.2.5 Chinook Salmon

Single juvenile chinook salmon (*O. tshawytscha*) were taken in purse seine sets at the two outer stations (27- and 20-m) on Transect 3 during Cruise 2 and at n-m stations on Transect 1, 2, and 4 in Cruise 3 (Table lo). The largest single catch was 10 fish on Transect 3, Station 1 on Cruise 2 (July 27). Only one juvenile chinook was taken in a beach seine; that was inside Ugashik Bay on Cruise 2.

4.2.6 Pink Salmon

Only five pink salmon (*O. gorbuscha*) juveniles were captured (on Transect 4, Station 1 in Cruise 2). This low catch rate was expected in an even-numbered year in this area.

4.2.7 Discussion of 1984 Salmonid Catches

Bristol Bay river-lake systems have the largest adult sockeye salmon runs in the North Pacific. Although there is considerable year to year variation, the annual runs since 1978 have all been greater than 25 million fish. The bay also supports annual runs of 2 to 3 million adult chum salmon and even larger runs of adult pink salmon in even-numbered years (about 16 million in 1978 and about 6 million in 1984)

TABLE 9

1984 PURSE SEINE CATCH FOR JUVENILE COHO[a]

Cruise	1				2				3				All Cruises			
Station	1	2	3	Wtd Avg	1	2	3	Wtd Avg	1	2	3	Wtd Avg	1	2	3	Wtd Avg
Transect:																
1					0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00
2		0.00	62.60	31.30					0.00	0.40	0.00	0.13	0.00	0.20	31.30	12.60
3		0.00	0.00	0.00	0.40	1.10	0.00	0.50		0.40	0.00	0.20	0.40	0.50	0.00	0.27
4	0.00	0.30	0.40	0.20	0.00	0.00	4.40	1.47		0.50	0.00	0.25	0.00	0.27	1.60	0.66
5		0.00	0.00	0.00	0.00	0.00	0.00	0.00			0.00	0.00	0.00	0.00	0.00	0.00
6					0.00	0.00	3.60	1.20		0.00	0.00	0.00	0.00	0.00	1.80	0.80
Weighted Averages:																
Station	0.00	0.08	15.75		0.09	0.22	1.60		0.00	0.29	0.00	All Trans	0.06	0.20	4.73	
Cruise				6.66				0.66				0.11	All Cruise Weighted Average			2.09

[a] Weighted averages of station means, standardized to 10-minute set times.

TABLE 10

1984 PURSE SEINE CATCH FOR JUVENILE CHINOOK[a]

Cruise	1				2				3				All Cruises			
Station	1	2	3	Wtd Avg	1	2	3	Wtd Avg	1	2	3	Wtd Avg	1	2	3	Wtd Avg
Transect:																
1					0.00	0.00	0.00	0.00		0.00	0.40	0.20	0.00	0.00	0.20	0.08
2		0,00	0.00	0.00					0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3		0.00	0.00	0.00	5.40	1.10	0.00	2.17		0.00	0.40	0.20	5.40	0.37	0.13	0.99
4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.50	0.25	0.00	0.00	0.17	0.06
5		0.00	0.00	0.00	0.00	0.00	0.00	0.00			0.00	0.00	0.00	0.00	0.00	0.00
6					0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00
Weighted Averages:																
Station	0.00	0.00	0.00		1.20	0.22	0.00		0.00	0.00	0.22	All Trans	0.77	0.08	0.09	
Cruise				0.00				0.45				0.11	All Cruise Weighted Average			0.22

[a] Weighted averages of station means, standardized to lo-minute set times.

(Table 11). The chum and pink adult salmon runs are concentrated in the west side of Bristol Bay (primarily Nushagak Bay), as are the less abundant runs of chinook and coho salmon.

The timing of the annual adult sockeye salmon runs to Bristol Bay is estimated by lagging the daily escapement counts back to the fishing district and adding the escapement to the catch. The lag time (i.e., the number of days it takes the fish to travel from the fishing district to the enumeration sites at the lake system outlets) has been estimated by comparing the timing of the annual catches with the timing of annual escapements. The method of estimating the timing of an annual run probably results in an error of one to two days, which is comparable to the variation in the estimated timing of the majority of the annual runs since 1960.

Late adult runs have been associated with cold spring weather, whereas early runs have generally followed warm spring weather. The latest run occurred in 1971 when 10 percent of the Nushagak run passed through the fishing district on July 5 (average date = June 28) and the mid-point of the run (50 percent) was on July 11 (average date = July 4). In that year, 10 percent of the Naknek-Kvichak run occurred on July 1 (average date = June 26) and the mid-point of the run was on July 8 (average date = July 2). The earliest run to begin was in 1979 when 10 percent of the Nushagak run occurred on June 23 and the Naknek-Kvichak run on June 21. The earliest mid-point of a run was in 1967, June 30 for the Nushagak, and June 28 for the Naknek-Kvichak.

Preliminary data obtained from ADF&G indicate that the 1984 adult run began earlier than average (10 percent on June 24 in the Nushagak and on June 25 in the Naknek-Kvichak), but the mid-point of the run was about average (July 3 in the Nushagak and July 4 in the Naknek-Kvichak).

The timing of the 1984 run was similar to the timing of the 1969 and 1970 Naknek-Kvichak runs but began about five days earlier than the 1969 and 1970 Nushagak runs. The 1984 run ended (90 percent) about July 12 to 13 (average July 11 for Nushagak and July 10 for Naknek-Kvichak) and was somewhat more prolonged than average.

TABLE 11

CATCHES AND ESCAPEMENTS OF SALMON IN BRISTOL BAY,
THE NORTH ALASKA PENINSULA, AND THE SOUTH PENINSULA INTERCEPTION FISHERY
1980-1984[a]

		Year of Run				
		1980	1981	1982	1983	1984
Sockeye						
East side[b]	Catch	17.2	17.4	8.6	31.4	22.2
	Escape	29.8	5.7	4.7	6.4	14.4
West side	Catch	5.0	8.3	6.6	5.9	2.5
	Escape	8.8	3.1	2.3	2.1	2.0
No. Pen.	Catch	1.4	1.8	1.4	2.0	1.7
So. Pen.[c]	Catch	3.3	2.0	2.0	2.2	2.1
Chum						
East side	Catch	0.3	0.5	0.3	0.6	0.8
West side	Catch	1.1	1.0	0.6	0.9	1.0
	Escape	1.4	0.5	0.3	0.3	0.6
No. Pen.	Catch	0.7	0.7	0.3	0.3	0.8
So. Pen.[c]	Catch	0.5	0.5	0.7	0.5	0.5
Pink						
East side	Catch	0.3	+	0.1	+	0.2
West side	Catch	2.4	+	1.3	+	3.2
	Escape	2.8	+	1.7	+	3.0
No. Pen.	Catch	0.3	+	+	+	+
Coho						
East side	Catch	+	+	0.1	+	0.1
West side	Catch	0.3	0.3	0.5	0.1	0.4
No. Pen.	Catch	0.1	0.2	0.2	0.1	0.2

[a] Source: ADF&G unpublished statistics; numbers in millions; + = less than 100,000.

[b] East side is Naknek-Kvichak, Egegik, and Ugashik, and West side is Nushagak and Togiak.

[c] Catches in June.

Interannual timing of the adult runs of the other species of salmon is difficult to determine because the historical record is based largely on catch statistics alone. The Nushagak chinook run begins about June 5, reaches a peak about June 20, and continues at a low level through July. The timing of the chum salmon run is similar to the sockeye run except that chums begin a little earlier and end a little later. The pink salmon run in even-numbered years begins about mid July, peaks about July 25 and ends about August 15. The coho run begins about July 20 and peaks in early August (Nushagak) or late August (Togiak). The end of the coho run is difficult to determine because fishing usually ends by late August. Based on preliminary data from ADF&G, the timing of the 1984 runs appeared to be about average for pinks and a little earlier than average for chinook, chum and coho salmon.

Each summer as the adult salmon return to Bristol Bay, from 100 to 500 million juvenile salmon migrate seaward. The Bristol Bay smelt migrations have been sampled in the various rivers since the 1950s (by BCF, FRI and ADF&G); however, only the Kvichak sockeye salmon smelt migration has been sampled each year. The juveniles are generally thought to concentrate closer to the coast of the Alaska Peninsula than the incoming adults; therefore, juveniles may be more susceptible to impacts from possible oil spills. Straty (1974) studied the distribution of juvenile sockeye salmon by purse seine sampling and marking experiments in 1969 and 1970 (see Section 2.2.1); however, his sampling was less focused in nearshore waters and bays than that of the present study.

The main purpose of our 1984 sampling effort was to determine the relative abundance of juveniles in the nearshore waters and to compare the inshore/offshore distribution in 1984 with the offshore distribution in 1969 and 1970.

Our purse seine catches in 1984 were unexpectedly low. Whereas Hartt and Dell (1978) and Straty (1974) reported sets often taking hundreds and occasionally thousands of juveniles, our catches were usually less than 10, often zero, and only occasionally exceeded 100 juveniles. The purse seine used in 1984 was about 60 percent of the length of the seine used in 1969-1970, and was held open for only 10 minutes as opposed to 30 minutes used by Straty (U.S. National Marine Fisheries Service - NMFS, Juneau; personal communication 1985). However, the 1984 catches were much less than 20 percent (60 percent x 1/3) of Straty's 1969 and 1970 catches which for comparable stations fished in 1984 averaged over 200 juvenile sockeye per haul. The parent escapements for the sockeye salmon smelts in 1984 were somewhat larger than the escapements for the 1969 and 1970 migrations, and the sonar-sampling program by the Alaska Department of Fish and Game (ADF&G) indicated that over 400 million sockeye salmon smelts migrated to sea in 1984 (Tables 12 and 13).

To explore why our catches in 1984 were so small, we examined the smelt migration in 1984 (preliminary data provided by ADF&G) and compared the characteristics of that migration with the migrations in other years, especially with regard to the timing and stock composition of the migration.

The interannual variation in the timing of migrations (i.e., the onset) is related to spring temperatures to the extent that colder temperatures delay the migrations. Recent sockeye smelt migrations have been relatively early (except 1982). Some measurements of spring temperatures are shown in Figure 16. Conditions in 1970 and 1984 were very similar (warm), whereas conditions in 1969 were colder than average. The water temperatures in the rivers were especially warm in 1984.

The Kvichak sockeye stock, which in most years is the largest in Bristol Bay, usually migrates from Lake Iliamna in late May to early June. Variation in the annual timing of the smelt migration is associated with the spring weather and the dates of ice breakup in the upper and middle portions of the lake (Figure 17). When the lake has been clear of ice before May 10, the migrations have begun in mid-May, as in 1984 and 1970; in 1969 the migration was about 10 days later.

The Wood River (and presumably other Nushagak) sockeye smelt migrations are usually later than the east side (including Kvichak) migrations

TABLE 12

BRISTOL BAY SOCKEYE SALMON ESCAPEMENTS AND ADULT RETURNS FOR THE 1969 and 1970 SMOLT MIGRATIONSa

Smelt Migration Year	Lake System	Escapements (Millions) for Smelts of Age 1	Age 2	Percent Age 1 in Smelts	Adult Return (Millions)	Percent Age 1 in Return
1969	East Side					
	Kvichak	3.2	3.8	52	4.7	10
	Branch	0.2	0.2	.-	0.3	94
	Naknek	0.8	1.0	60	1.3	55
	Egegik	0.6	0.8	--	1.4	16
	Ugashik	0.2	0.7	60	0.2	46
	Total	5.0	6.5		7.9	23
	West Side					
	Wood	0.5	1.2	91	0.7	89
	Igushik	0.3	0.2	--	0.2	89
	Nuyakuk	0.02	0.2	--	0.1	88
	Togiak	0.1	0.1	--	0.1	89
	Total	0.9	1.7		1.1	89
1970	East Side					
	Kvichak	2.6	3.2	38	1.0	27
	Branch	0.2	0.2	--	0.2	76
	Naknek	1.0	0.8	55	0.8	32
	Egegik	0.3	0.6	--	1.0	7
	Ugashik	0.1	0.2	58	0.1	25
	Total	4.2	5.0		3.1	25
	West Side					
	Wood	0.6	0.5	98	0.8	87
	Igushik	0.2	0.3	--	0.2	87
	Nuyakuk	0.1	0.02	--	0.2	96
	Togiak	0.1	0.1	--	0.2	80
	Total	1.0	0.9		1.4	

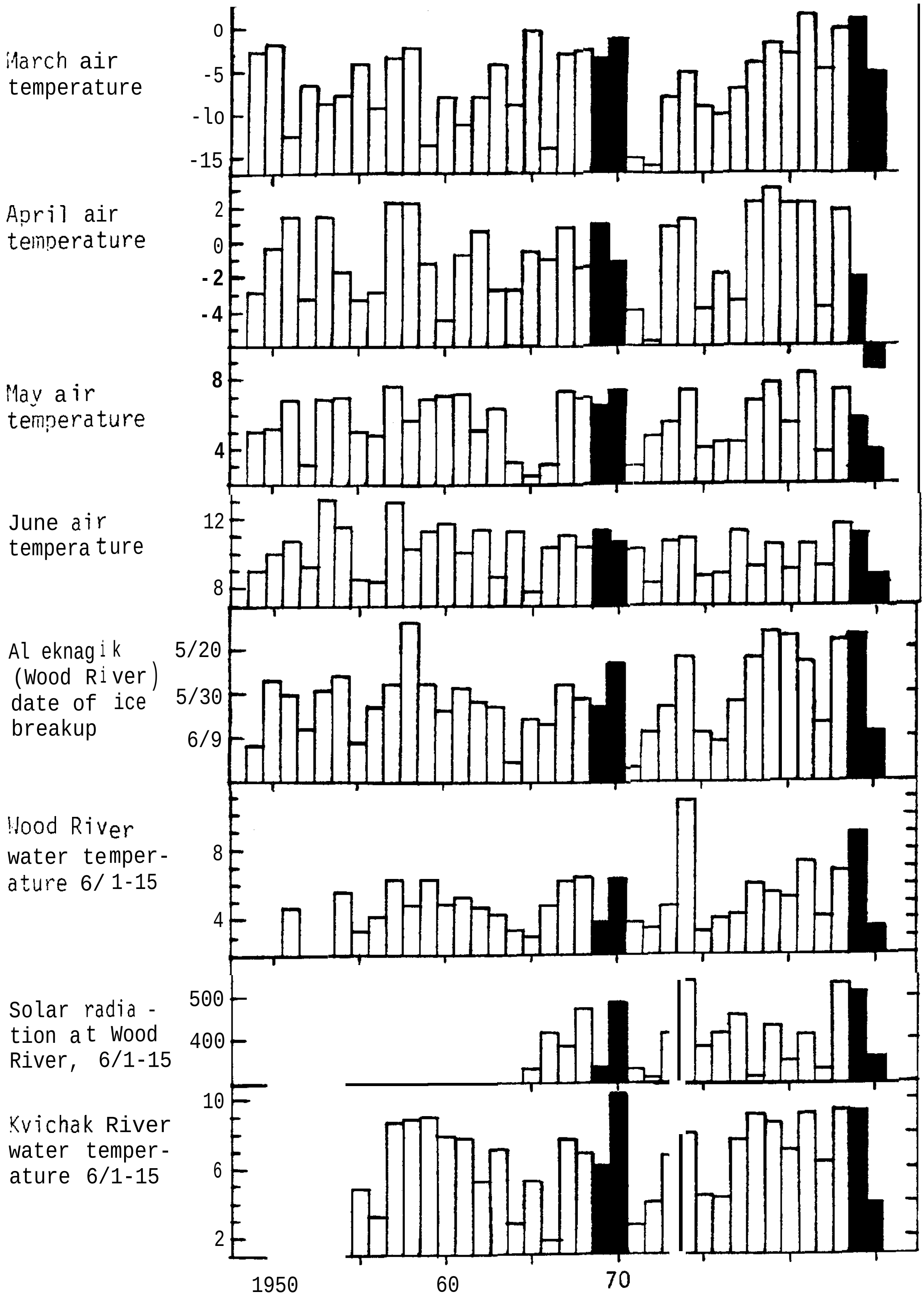
a Source: ADF&G, unpublished statistics

TABLE 13

BRISTOL BAY SOCKEYE SALMON ESCAPEMENTS FOR THE
1984 and 1985 SMOLT MIGRATIONS[a]

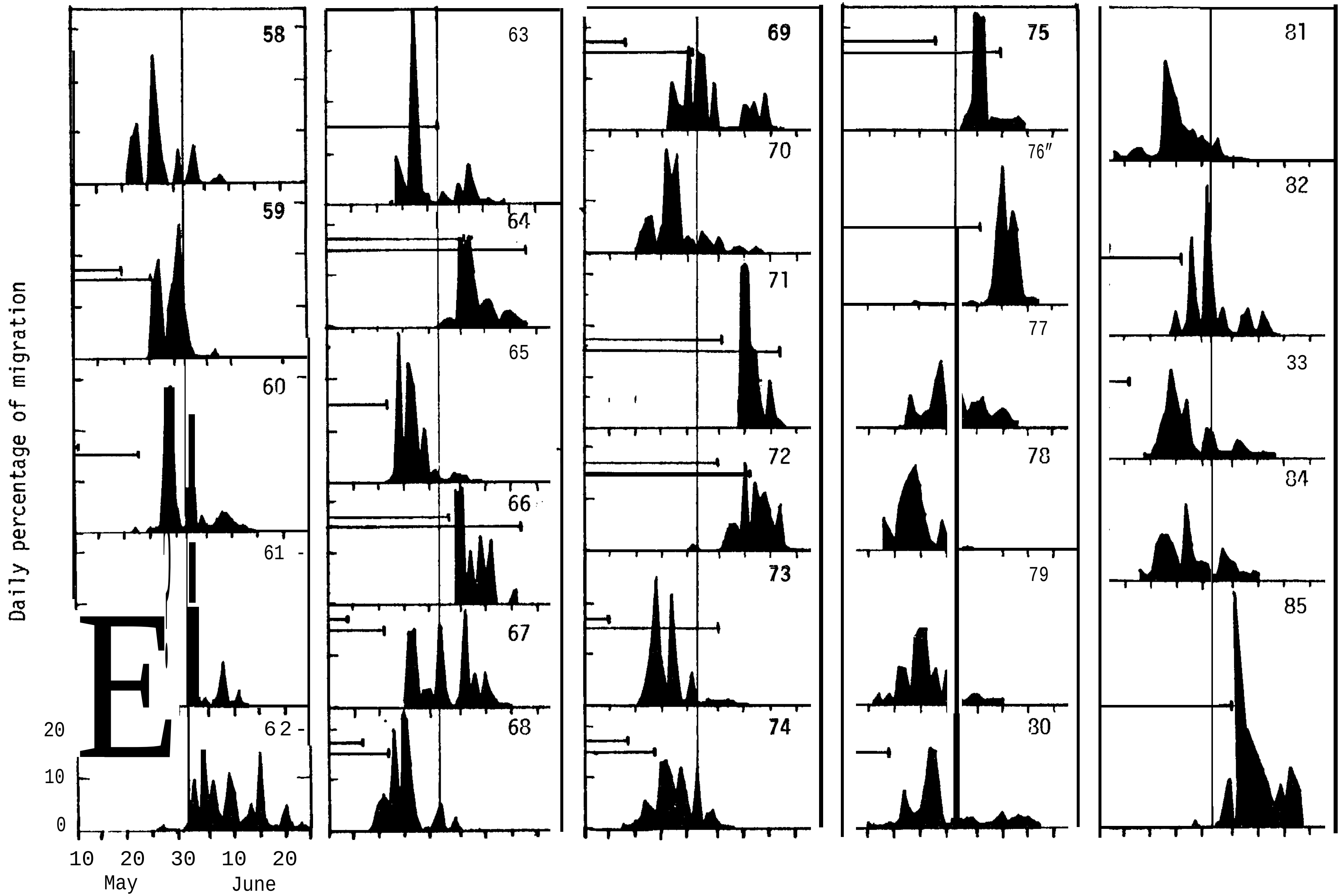
Smelt Migration Year	Lake System	Escapements (Millions) for Smelts of Age 1	Age 2	Number Migration (Millions)	Percent Age 1 in Migration
1984	East Side				
	Kvichak	1.1	1.8	90	58
	Branch	0.2	0.1	.-	--
	Naknek	1.2	1.8	81	40
	Egegik	1.0	0.7	49	35
	Ugashik	1.2	1.3	158	48
	Total	4.7	5.7	378+	47
	West Side				
	Wood	1.0	1.2	24	94
	Igushik	0.4	0.6	--	--
	Nuyakuk	0.5	0.8	6	99
	Togiak	0.2	0.2	--	--
	Total	2.1	2.8		
1985	East Side				
	Kvichak	3.6	1.1		
	Branch	0.1	0.2		
	Naknek	0.9	1.2		
	Egegik	0.8	1.0		
	Ugashik	0.1	1.2		
	Total	6.4	4.7		
	West Side				
	Wood	1.4	1.0		
	Igushik	0.2	0.4		
	Nuyakuk	0.3	0.5		
	Togiak	0.2	0.2		
	Total	2.1	2.1		

[a] Source: ADF&G, unpublished statistics



Comparisons of Spring Weather Conditions in Bristol Bay for 1969-70 and 1984-85 Smelt Migrations

(Source: FRI and ADF&G unpublished data: US Weather Bureau statist'its.)



Timing of Kvichak Sockeye Smelt Migrations. Daily Percentage of Total Migration

Vertical line at 1 June. Horizontal lines indicate ice on upper and lower lake.
(Source: FRI and ADF&G, unpublished data.)

Figure 17

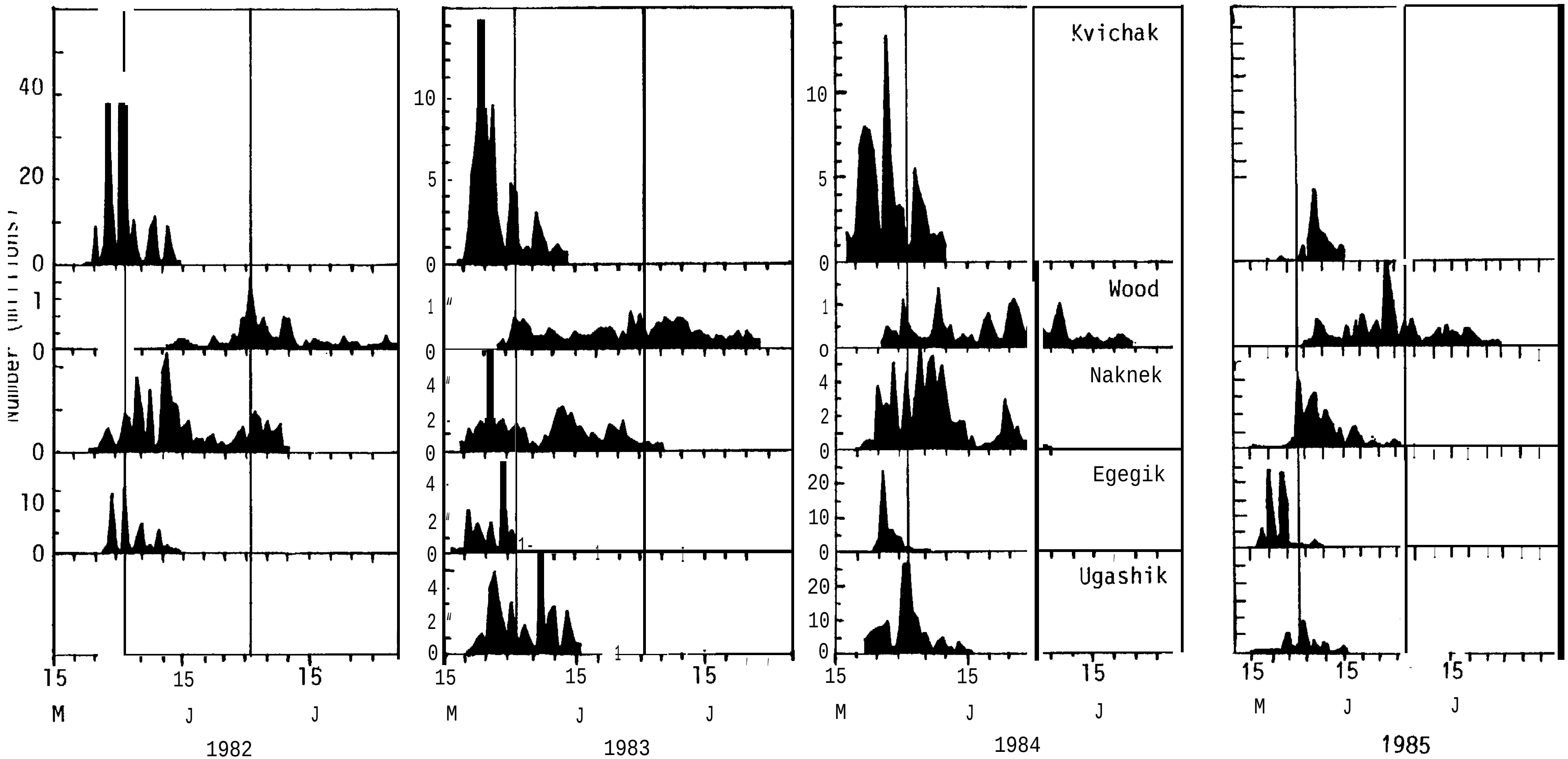
Dames & Moore

because ice breakup is later (Figure 18). The outmigrations from the Wood River and Naknek systems tend to be more prolonged than those from many systems because these are multi-lake systems.

Sockeye salmon juveniles can travel 'at sustained rates of 1 to 2 body lengths (b.l.) per second (Hoar and Randall 1978) or about 10 km per day for typical Bristol Bay smelts. Although precise migration speeds through Bristol Bay are unknown, the marking experiments by Straty (1974) indicated that a speed of 1 b.l./sec was certainly possible (Figure 19). Juveniles may slow their migration in outer Bristol Bay as indicated by the recovery of three marked Ugashik sockeye at Port Moller in mid-September 1970. At a constant migration speed of 1 b.l./sec these marked juveniles would have been well beyond Port Moller by mid-September.

The timing of past juvenile sockeye migrations at Port Heiden was examined with an assumed travel rate of 1 b.l./sec and nearly linear migration routes from the lake outlets. Ugashik (and presumably Egegik) juveniles hardly overlapped the distribution of Kvichak or Wood River fish; the distributions of these stocks only overlapped significantly in 1962 (Figure 20).

There was an exceptionally large migration from Ugashik and a rather small migration from Wood River in 1984 (Tables 14 and 15). The projected timing of the 1984 Bristol Bay sockeye salmon juvenile migration at Port Heiden is depicted in Figure 21. In this projection, the number of Wood River smelts was doubled to provide an estimate for smelts from the entire Nushagak District, and the timing was estimated assuming a migration rate of 10 km/day as well as 1 b.l./sec. Since our sampling did not" begin until about the first of July it is likely that we missed most of the Ugashik and Egegik migrations in 1984. The estimated migrations in 1982 and 1983 are shown for comparisons in Figures 22 and 23. Clearly the distribution of juveniles can vary considerably from year to year depending on the magnitudes of the stocks, the size of the smelts and spring weather.

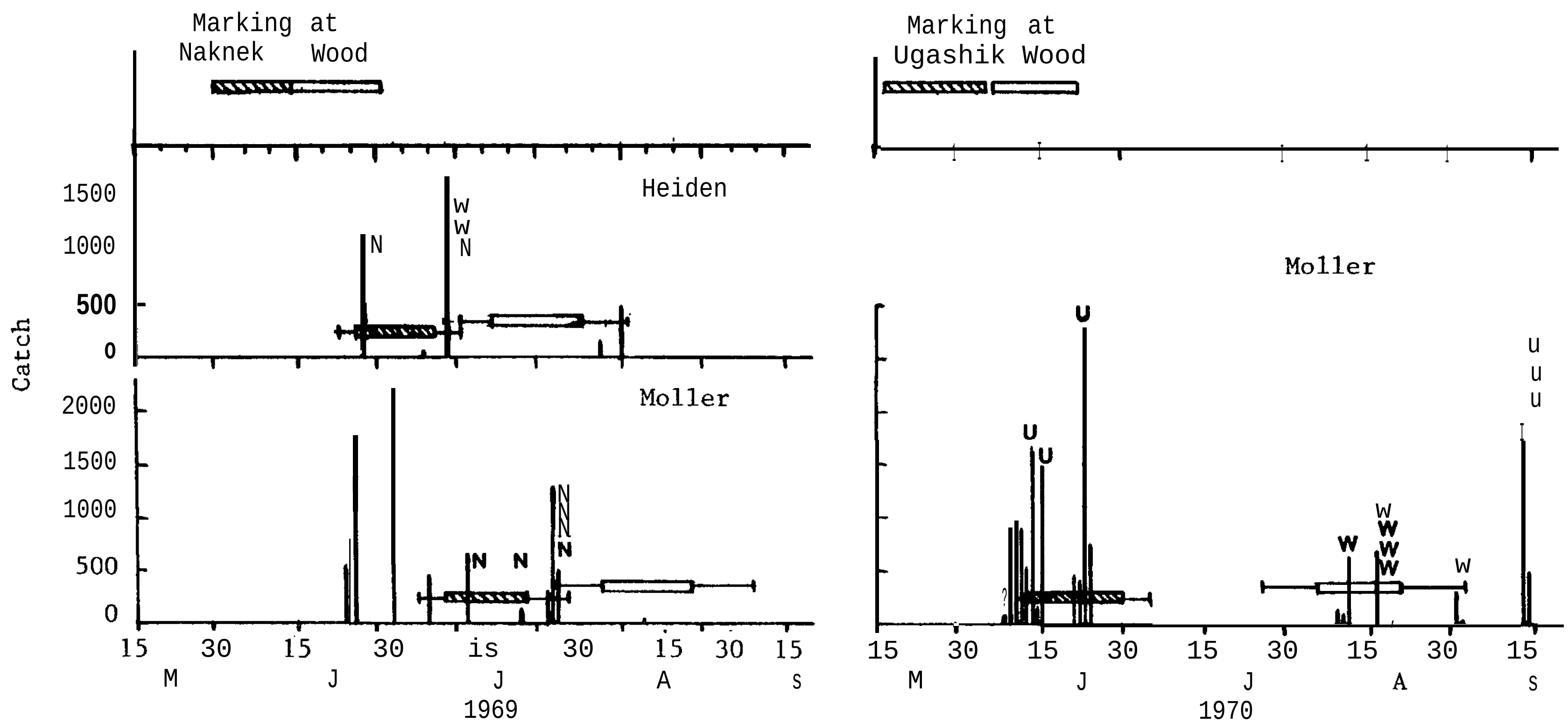


Daily Sockeye Salmon Smelt Migrations from Bristol Bay Lake Systems, 1982-1985

Vertical lines at June 1 and July 1. (Source: FRI and ADF&G, unpublished data.)

Figure 16

Dames & Moore

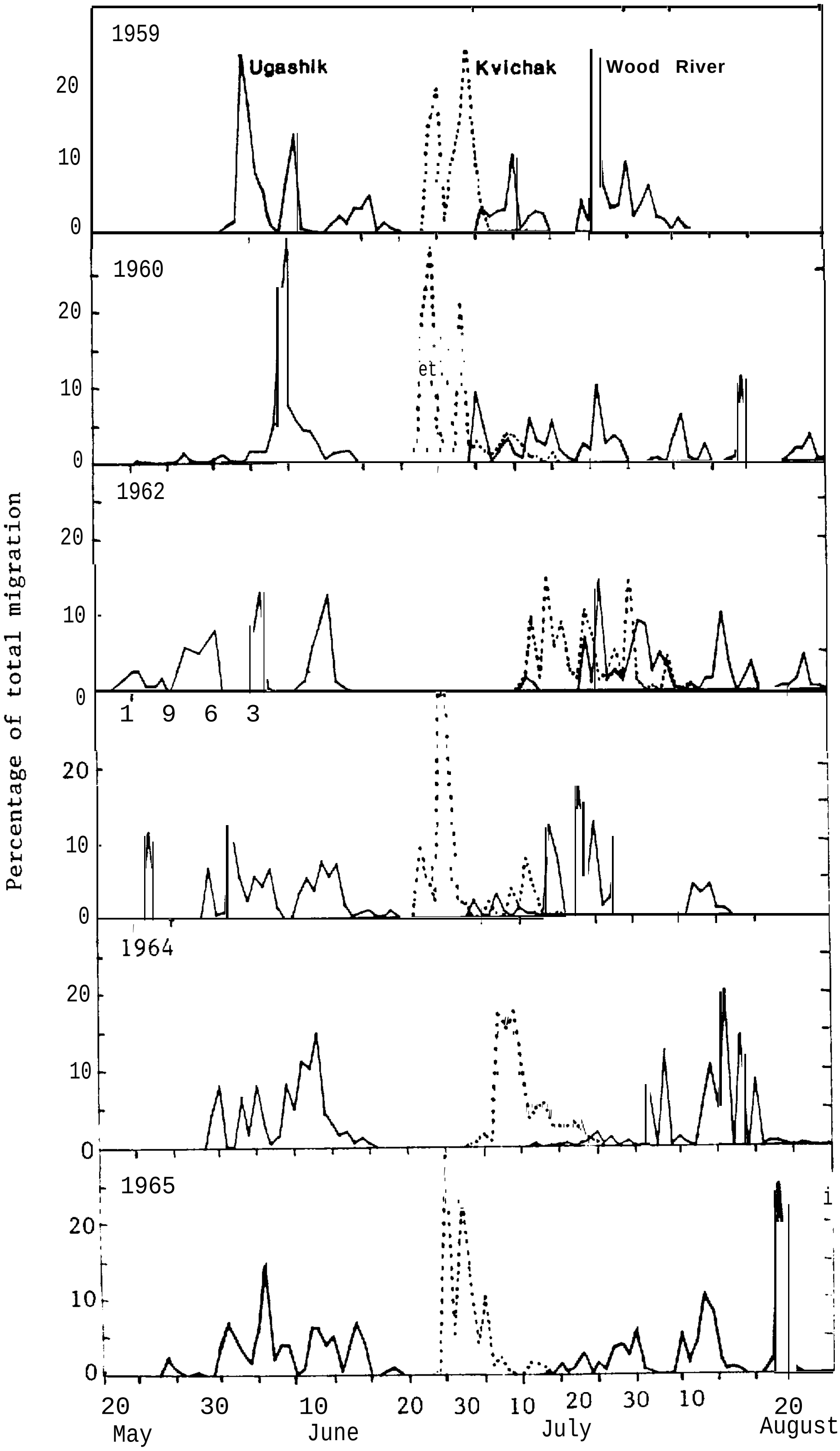


Periods of Sockeye Smelt Marking and Recovery of Marked Juveniles off Port Heiden and Port Moller Relative to the Number of Juveniles Caught and the Expected Migration Timing at One Body Length Per Second

(Horizontal bar and lines indicate expected time of arrival for fish of typical mean length and full size range, respectively.) (Source: Straty 1974, and Bureau of Commercial Fisheries catch statistics provided by H. Jaenicke).

Figure 19

Dames & Moore



Predicted Timing of Ugashik, Kvichak, and Wood River Sockeye Juveniles off Port Heiden Based on a Migration Rate of One Body Length Per Second, and Fyke Net Sampling at the Lake System Outlets, 1959-60 and 1962-65

(Source: FRI, Bureau of Commercial Fisheries, and ADF&G, unpublished statistics.)

Dames & Moore

Figure 20

TABLE 14

BRISTOL BAY SOCKEYE SALMON SMOLT MIGRATION, 1984a

Lake system	Age I Number (millions)	Age I Mean length (mm)	Age I Mean wt. (g)	Age II Number (millions)	Age II Mean length (mm)	Age II Mean wt. (g)	Parent escapement (millions) Age I (1982)	Parent escapement (millions) Age II (1981)
Kvichak	51.9	90.2	6.8	37.6	103.7	10.0	1.1	1.8
Naknek	32.1	97.0	8.8	48.8	107.7	11.4	1.2	1.8
Egegik	17.2	105.8	10.1	32.2	112.5	12.2	1.0	0.7
Ugashik	75.5	87.2	6.8	82.7	101.6	10.3	1.2	1.3
Wood	22.2	92.3	7.8	1.4	96.8	8.7	1.0	1.2
Nuyakuk	6.3	81.1	4.9	0.1	92.6	7.3	0.5	0.8
Igushik	--			--			0.4	0.6
Togiak	--			--			0.2	0.2

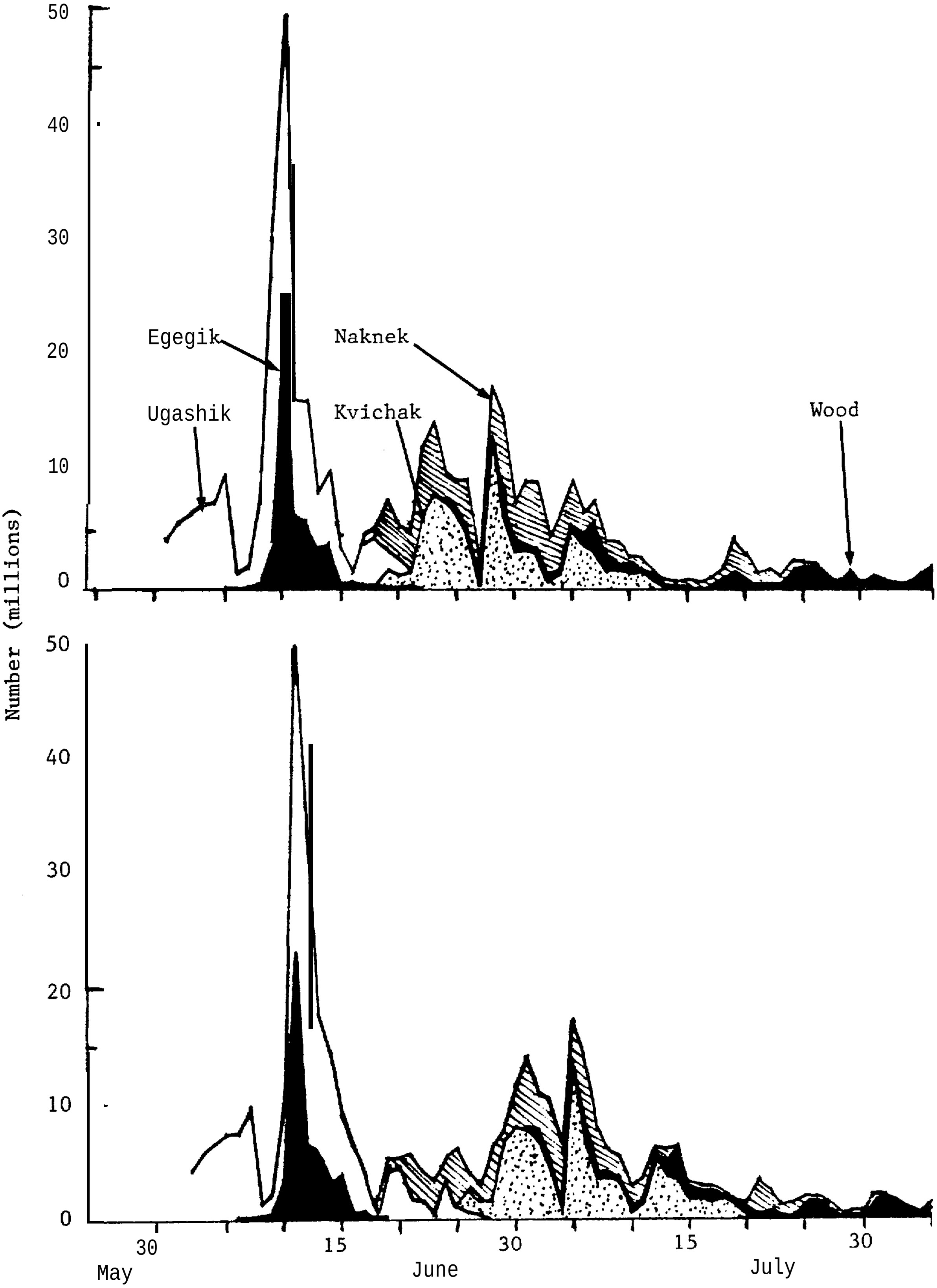
[a] Source: H. Yuen, ADF&G, Anchorage

TABLE 15

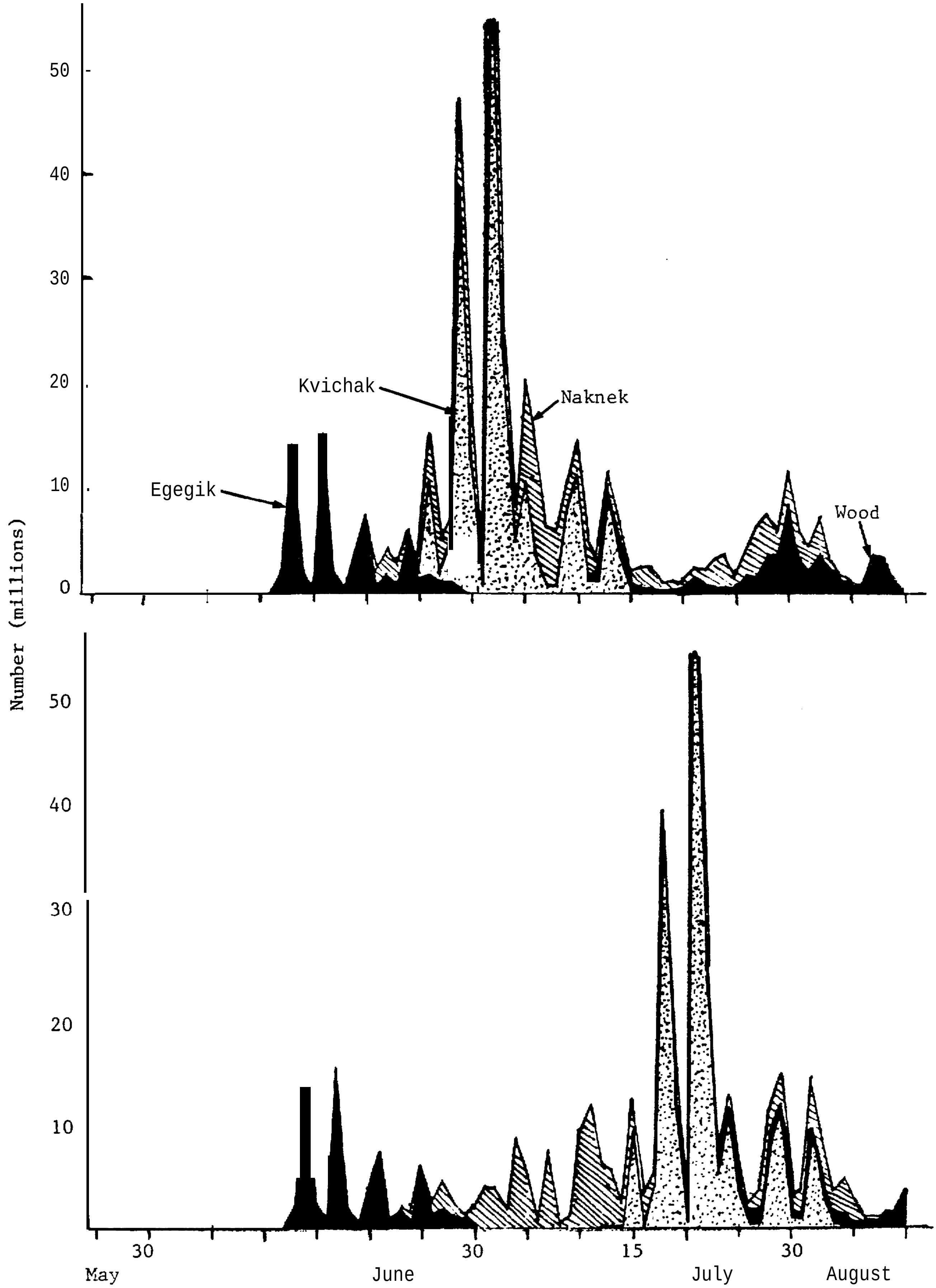
BRISTOL BAY SOCKEYE SALMON SMOLT PRODUCTION BY BROOD YEAR, 1979-82[a]

Lake system	Brood year	Escape. (millions)	Number of smelts (millions) Age I	Age II	Total	Smelts/escape.
Kvichak	1979	11.2	163.0	81.1	244.1	22
	80	22.5	122.9	76.2	199.1	9
	81	1.8	6.5	37.6	44.1	24
	82	1.1	51.9	--	--	--
	83	3.6	--	--	--	--
Naknek	1979	0.9	--	12.9	--	--
	80	2.6	115.6	16.5	132.1	51
	81	1.8	36.8	48.8	85.6	48
	82	1.2	32.1	--	--	--
	83	0.9	--	--	--	--
Egegik	1979	1.0	--	14.3	--	--
	80	1.1	49.5	16.5	66.0	60
	81	0.7	2.2	32.2	34.4	49
	82	1.0	17.2	--	--	--
	83	0.8	--	--	--	--
Ugashik	1979	1.7	--	--	--	--
	80	3.3	--	12.7	--	--
	81	1.3	31.3	82.7	114.0	88
	82	1.2	75.5	--	--	--
	83	1.0	--	--	--	--
Wood	1979	1.7	64.3	4.7	69.0	41
	80	3.0	32.4	4.1	36.5	12
	81	1.2	19.6	1.4	21.0	18
	82	1.0	22.3	--	--	(23)
	83	1.4	--	--	--	--

[a] Source: ADF&G unpublished statistics.



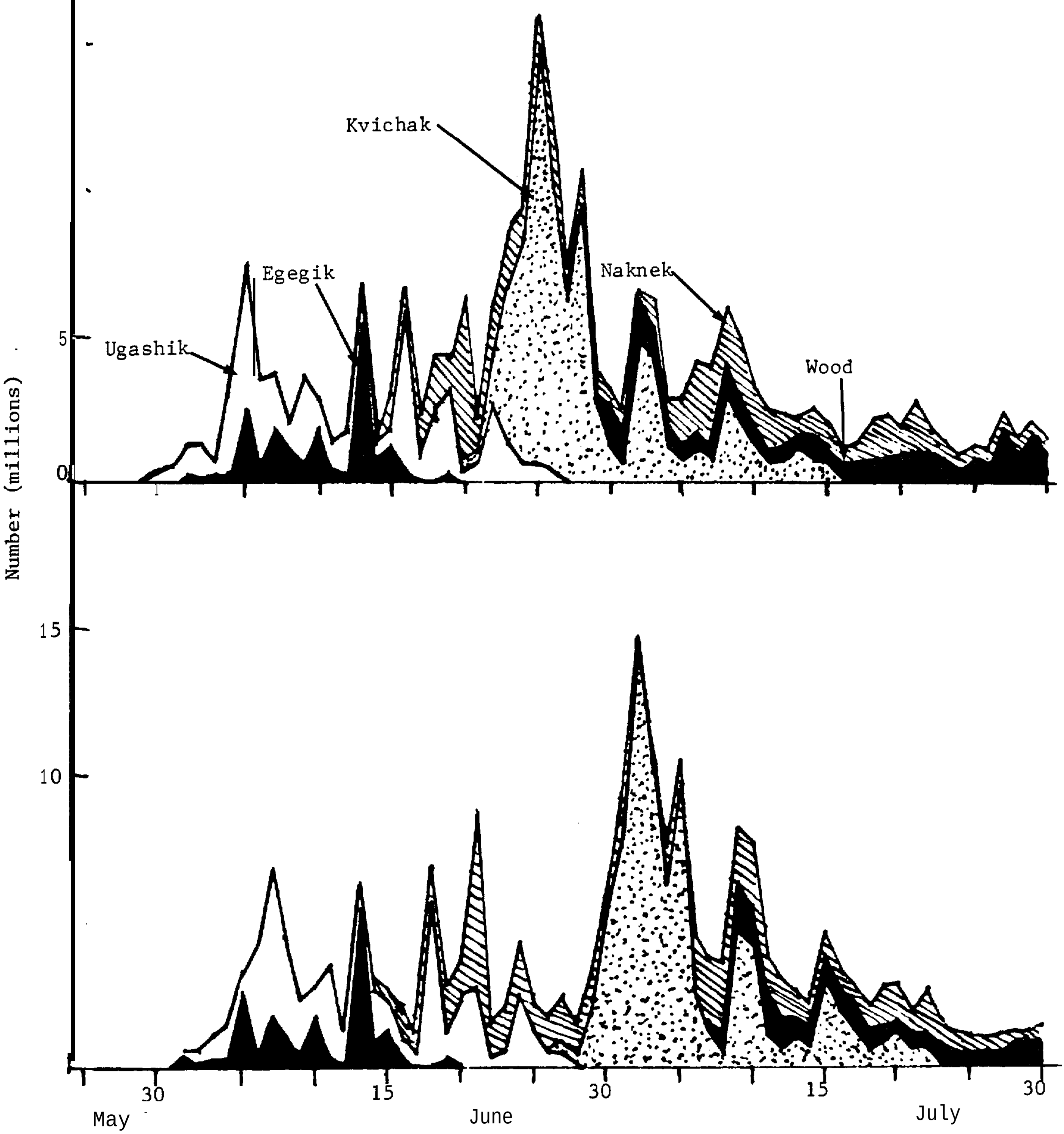
Predicted Timing of the Sockeye Juvenile Migration at Port Heiden in 1984 Based on Migration Rates of 10 km per day (top) and One Body Length Per Second (bottom)



Predicted Timing of the Sockeye Juvenile Migration at Port Heiden in 1 982 Based on Migration Rates of 10 km per day (top) and One Body Length Per Second (bottom)

Dames & Moore

Figure 22



Predicted Timing of the Sockeye Juvenile Migration at Port Heiden in 1983 Based on Migration Rates of 10 km per day (top) and One Body Length Per Second (bottom)

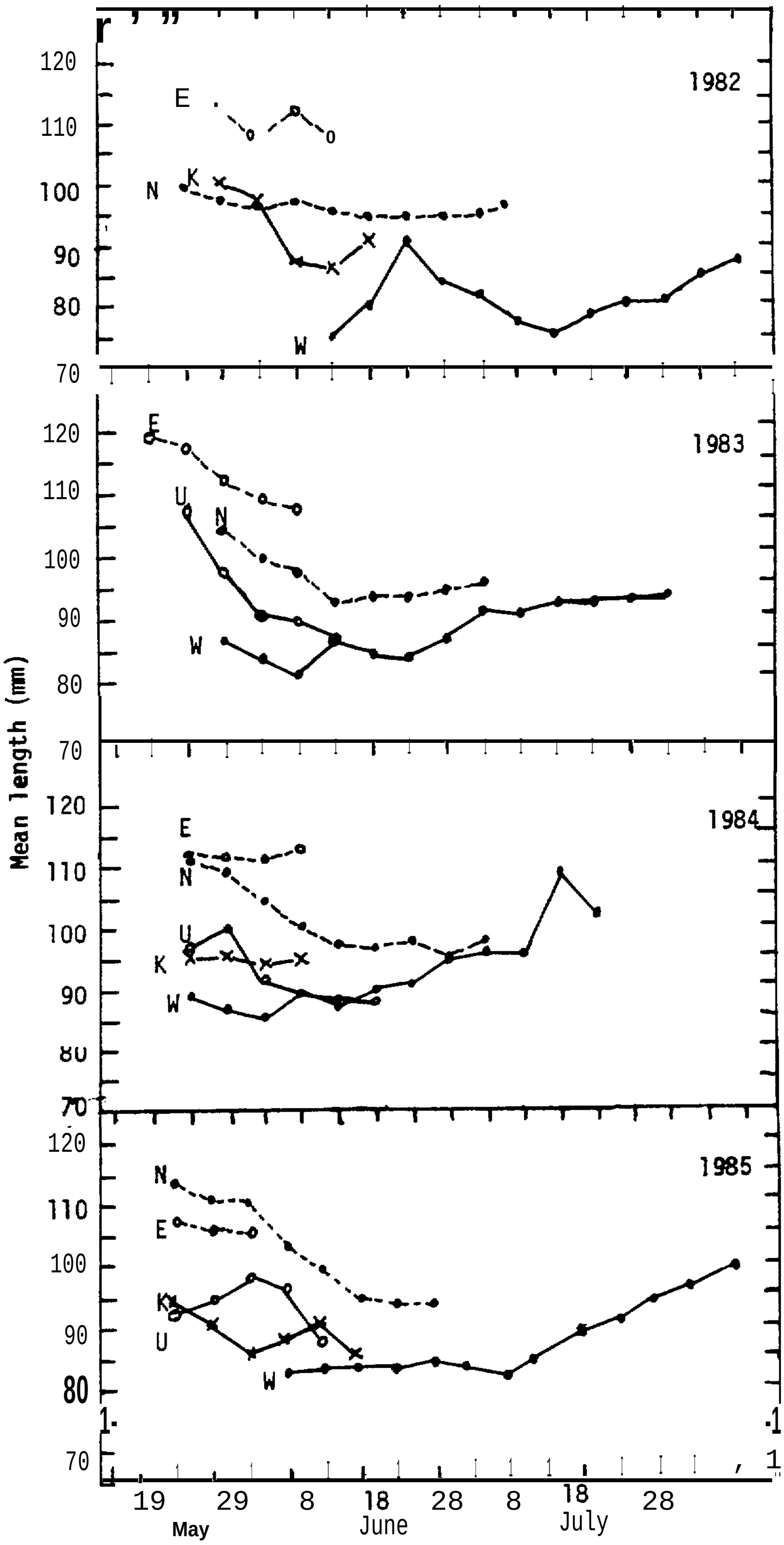
Dames & Moore

Figure 23

The 1984 Wood River smelts were the largest (average length 92.3 mm) observed for that system since 1951; they typically average only 80 to 85 mm and are usually the smallest smelts migrating from Bristol Bay. Smelts from Egegik (Lake Becharof) are usually the largest in Bristol Bay, and this was the case in 1984 (Figure 24).

Most of the juvenile sockeye salmon in 1984 were probably beyond our sampling area after the first cruise (e.g., by late July) and most of those that were present (e.g., Cruise 2) were probably from the Nushagak District. Juvenile chum salmon, which are smaller (3-4 cm) than sockeye salmon at migration and come predominantly from the Nushagak River, were likely the most abundant salmonid in the outer Bay after the first of August (Table 16). Juvenile chum salmon were co-dominant with the sockeye in the second cruise (Figure 8). The lack of catches beyond Port Moller in early September may indicate that most of the Nushagak chum salmon had not yet arrived there by that time or that fish had moved off shore by this time.

A second hypothesis (not at all mutually exclusive with the first, as discussed above) considered to explain our relatively low catches of juvenile salmonids in nearshore sampling, compared with catches by Hartt and Dell (1978) and Straty (1974) offshore, was that these fish simply do not use the nearshore zone to the degree that they use offshore waters. Various accounts of early marine life history of juvenile salmon have indicated movements generally following shorelines (e.g., Bax et al. 1980, Dames & Moore 1983). As fish increase in size, there is a known tendency to move to deeper waters, and species migrating as larger juveniles (e.g., chinook and coho) tend to favor deeper or more open water habitats (e.g., Simenstad et al. 1982). Simenstad et al. (p. 352) observe that, in Puget Sound, sockeye juveniles "move directly in neritic habitats and show no affinity for nearshore habitats." In our study area the dynamic nature of the coastline, with its wave action and wave-generated turbidity, may reduce the desirability of nearshore habitats to the point where even smaller juvenile salmonids move farther



Mean Lengths of Sockeye Salmon Smelts by 5-day Periods m Migrations from Egegik (E), Kvichak (K), Naknek (N), Ugashik (U), and Wood River(W) Lake Systems, 1982-1985

Dames & **Moore**

Figure 24

TABLE 16

MEAN PURSE SEINE CATCHES OF JUVENILE SALMON BY LOCATION AND DATE OF SAMPLING AND THE ESTIMATED ABUNDANCE OF SOCKEYE SALMON ASSUMING TWO RATES OF TRAVEL

Cruise	Sampling location		Date	No. of hauls	Mean standard catch			Sockeye abundance	
					Sockeye	Chum	Total[a]	A	B
I	Transect	1		0	--	--	--	--	--
	(Heiden)	2	7/3	4	0.9	0	31.7	4	10
		3	7/1	4	2.2	0	2.2	14	6
	(Moller)	4	6/29	6	3.6	0	3.8	10	18
			7/1	1	2.9	0	2.9	2	9
		5	7/15	4	0.2	0.4	0.6	5	6
	(Izembek)	6		0	--	--	--	--	--
II	Transect	1	7/27	6	10.8	0	10.8	1	2
	(Heiden)	2		0	--	--	--	--	--
		3	8/2-3	6	13.3	16.1	32.1	2	1
	(Moller)	4	8/12	6	0.5	0	2.7	1	2
		5	8/5	5	0.8	0	0.8	2	7
	(Izembek)	6	8/10	6	0.1	0	1.3	3	6
III	Transect	1	9/12	4	1.5	27.1	27.1	≤2	≤2
	(Heiden)	2	9/11	6	0.6	1.7	2.4	≤2	≤2
		3	9/8	4	0	0.8	1.2	≤2	≤2
	(Moller)	4	9/4	4	0	1.2	1.7	≤2	≤2
		5	9/2	2	0	0	0	≤2	≤2
	(Izembek)	6	9/2	3	0	0	0	≤2	≤2

[a] Total includes coho, pinks and chinook (mostly coho)

[b] Number in millions assuming travel rates of 10 km/day (A) and 1 body length/see (B)

offshore soon after leaving their home estuary. It may also be that the unusually rough weather during the 1984 sampling period could have increased the tendency to use more offshore habitats. This distributional pattern was suggested in our Cruise 2 (late July to mid-August, 1984) purse seine results (Tables 6 through 8), but did not hold for all species in the 1985 results (Section 4.3). Our trend of diminishing purse seine catches with distance down the peninsula (which did hold in 1985) could also be symptomatic of an increasing tendency, with time in the marine environment, for juvenile salmon to move offshore.

Examination of 1966 and 1968 catches of sockeye and chum juveniles, broken down from raw data of Hartt and Dell (1978) in Appendix F, reveals a shift in peak catches from their stations closest to shore to mid-bay station in September (contrast Appendix F, Figures F-7 and F-8; F-15 and F-16). Thus, the tendency to abandon the nearshore areas may become more pronounced later in the summer as fish size increases.

4.3 SALMONIDS - 1985

Initiation of sampling in 1985 was timed to coincide with the beginning of smelt outmigrations from Bristol Bay river systems, which was relatively late due to cold spring temperatures. Sampling began off Port Moller on June 16 and continued up-bay to intercept the peak in abundance of early-migrating smelts from Egegik and Ugashik rivers. We reversed direction at Ugashik and worked back and forth over the study area as many times as weather and time allowed, averaging 1 transect each 2.5 days. The survey was concluded on July 28 at Ugashik.

4.3.1 General Catch Patterns

Catches in the study area in 1985 confirmed that large numbers of salmonids seasonally inhabit the nearshore waters of the North Aleutian Shelf (e.g., inshore of 10 nautical miles). Juveniles of all five species of Pacific salmon, as well as adult sockeye, chum, pink, and Dolly Varden were taken by the various gear employed. Of the 15,619 juvenile salmonids captured (Table 17), sockeye was the most abundant species (59.2 percent), followed by chum (32.9 percent), pink (6.1 percent),

TABLE 17

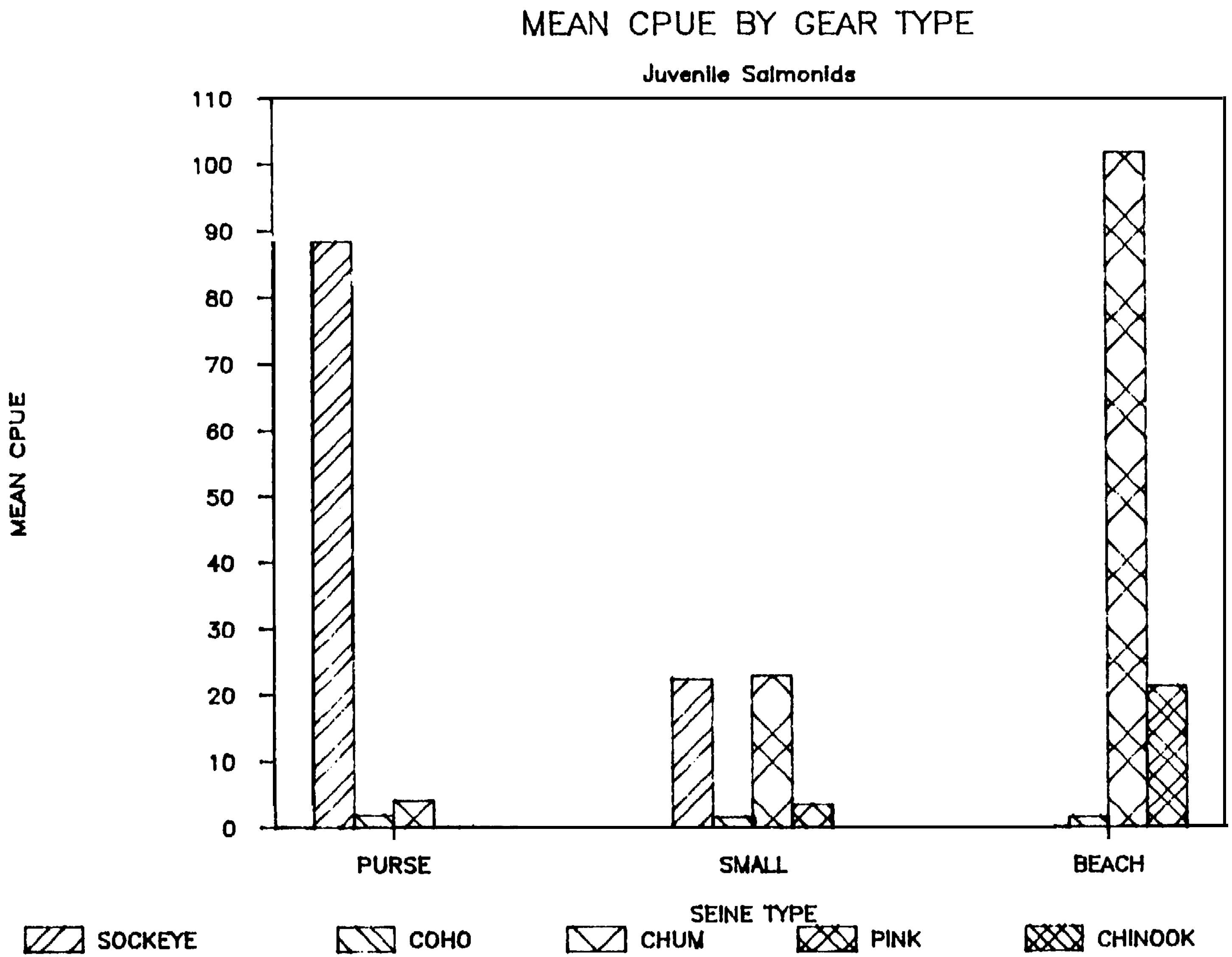
CATCHES OF JUVENILE SALMON BY GEAR TYPE IN 1985

GEAR	SETS	NUMBERS CAUGHT					TOTAL
		SOCKEYE	COHO	CHUM	PINK	CHINOOK	
PURSE SEINE	97	8,498	178	403	5	2	9,084
SMALL SEINE	34	738	52	758	115	2	1,665
BEACH SEINE	41	5	61	3,970	832	2	4,870

coho (1.9 percent), and chinook (0.04 percent). Mean CPUE for all gear types combined was highest for sockeye (54.1), followed by chum (30.5), pink (5.7), coho (1.7), and chinook (0.04). However, mean CPUE for each species was strongly gear dependent (Figure 25).

To the extent that it reflects actual species distributions, the pattern of catch by gear type suggests marked habitat affinities for most species (Figure 26). While juvenile sockeye were most ubiquitous in the study area and were taken in nearly all transect/gear combinations, catches described a generally offshore distribution, with comparatively little use of estuarine or littoral habitats. Coho juveniles were taken commonly, but not consistently, in nearshore and estuarine habitats throughout the survey period. They were present in equal abundance inside estuaries and offshore within 5.0 nm of shore. Pink and chum salmon juveniles were restricted largely to intertidal habitats, although movement offshore was detected late in the survey period. Their distributions showed the high degree of spatial overlap typical of these two species. Since only six juvenile chinook were captured by all gears during the survey, we hesitate to make inferences about habitat use by this species. Habitat used by all species is most probably a function of fish size and, therefore, time of sampling.

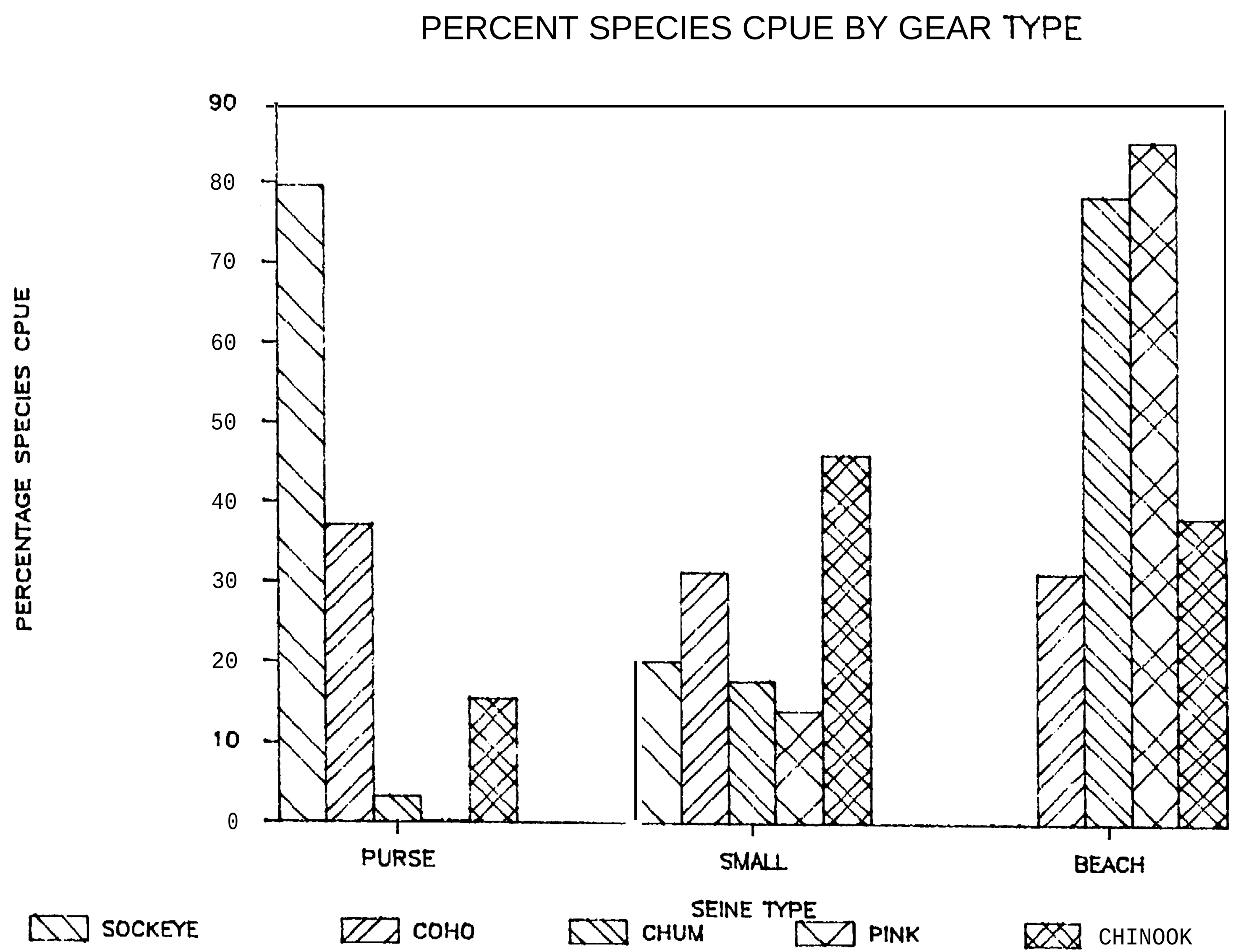
Adult sockeye, chum, pink, and Dolly Varden were taken mainly in offshore purse seine sets, but a few adult chums and Dolly Varden also were caught inside Port Moller. Largest catches of adult sockeye were taken at stations on the Ugashik transect near the terminal fishing grounds, and a relatively large catch of adult chums was taken in the small seine inside Herendeen Bay. Since the distributions and relative abundances of adult salmon in fishing districts within the study area are documented quite well by ADF&G commercial catch records, our catches of adults were considered to be incidental to the survey objectives. However, stomach samples removed from adult sockeye taken at the Ugashik transect on two separate occasions revealed intensive feeding activity much farther into inner Bristol Bay than expected.



1985 Juvenile Salmon Mean Catch By Gear Type

Figure 25

Dames & Moore



1985 Juvenile Salmon Percentage Catch By Gear Type

Dames & Moore

Figure 26

4.3.2 Adult Salmonids

Catches of adult salmonids in any gear were so infrequent that no attempt has been made to discern trends. This is not to say that adults were not abundant in the study area. A breakdown of 1985 commercial catches and escapements of all species in the study area by ADF&G statistical sub-area is provided in Table 18. Nearly 4.6 million adult salmon of all species returned to natal streams or were caught within the NAS study area in 1985. The distribution of abundance of locally produced adult salmon was centered around Port Moller and Bear River (the Ilnik/Three Hills fishery is suspected to intercept sockeye of Bristol Bay origin). Substantial escapements of all species again point to the importance of the Port Moller vicinity as a center of production of salmonids on the north side of the Alaska Peninsula. A chum salmon stock of moderate size apparently utilizes Izembek Lagoon, judging from catches up to 300,000 and escapements of nearly 450,000 in the years since 1977 (see Appendix J for a summary of North Peninsula fishery statistics) .

One of the more significant results of adult salmon catches in the large seine is the fact that sockeye salmon were found to be feeding within inner Bristol Bay. Stomachs of five sockeye sampled from catches on June 14 and July 20 at the Ugashik transect were filled to capacity with freshly consumed euphausiids. Many fishery biologists have in the past tacitly assumed that feeding ceases in maturing Bristol Bay sockeye as they enter the outer approaches to the Bay (cf., Straty and Jaenicke 1980). Our data show that sockeye continue to feed aggressively in the inner Bay to at least Ugashik. The ultimate destination of adults feeding at this location is not known.

4.3.3 Juvenile Salmon

4.3.3.1 Sockeye Salmon

The large purse seine was by far the most effective gear for catching juvenile sockeye salmon. Mean CPUE for the entire 1985 survey

TABLE 18

PRELIMINARY ADF&G ESTIMATES OF ESCAPEMENTS (TOP NUMBER) AND COMMERCIAL CATCHES OF ADULT SALMON WITHIN THE NAS STUDY AREA IN 1985[a] (SOURCE: A. SHAUL, AREA MANAGEMENT BIOLOGIST)

LOCATION	SOCKEYE	CHUM	COHO	CHINOOK	PINK	TOTAL
CINDER	12600	3200	13300	700	0	29500
RIVER	400	0	13500	0	0	13900
PORT	45500	26500	40000	4700	0	116700
HEIDEN	5100	0	13400	4400	0	22900
ILNIK/	22700	200	35000	0	0	57900
3 HILLS	978700	87300	3100	1700	0	1070600
BEAR	451500	5200	0	1200	0	457900
RIVER	823100	68000	16200	4800	800	913723
NELSON	314800	13000	18000	3200	0	349000
LAGOON	700000	6700	90200	10900	700	808500
HERENDEEN	700	71700	0	0	0	72400
PT. MOLLER	4900	262000	4900	1800	100	273700
BLACK	3700	4100	0	3200	0	11000
HILLS	0	0	0	0	0	0
IZEMBEK	17200	194700	0	0	0	211900
LAGOON	6200	126600	0	0	0	132800
BECHEVIN	200	21900	0	0	1400	23500
BAY	0	0	26700	0	1900	28600
TOTAL	3387300	891100	274000	36600	4900	4593900

(adjusted to 10.0 min sets) was 79.7 sockeye/set of the large seine, compared to 22.4 for the small purse seine and 0.1 for the beach seine. Aside from a few rather large catches in the small seine which indicated the presence of juvenile sockeye inside Herendeen Bay, the small seine and beach seine catch data described infrequent utilization of estuarine and littoral habitats. The following discussion therefore is limited to results of the offshore component of the survey.

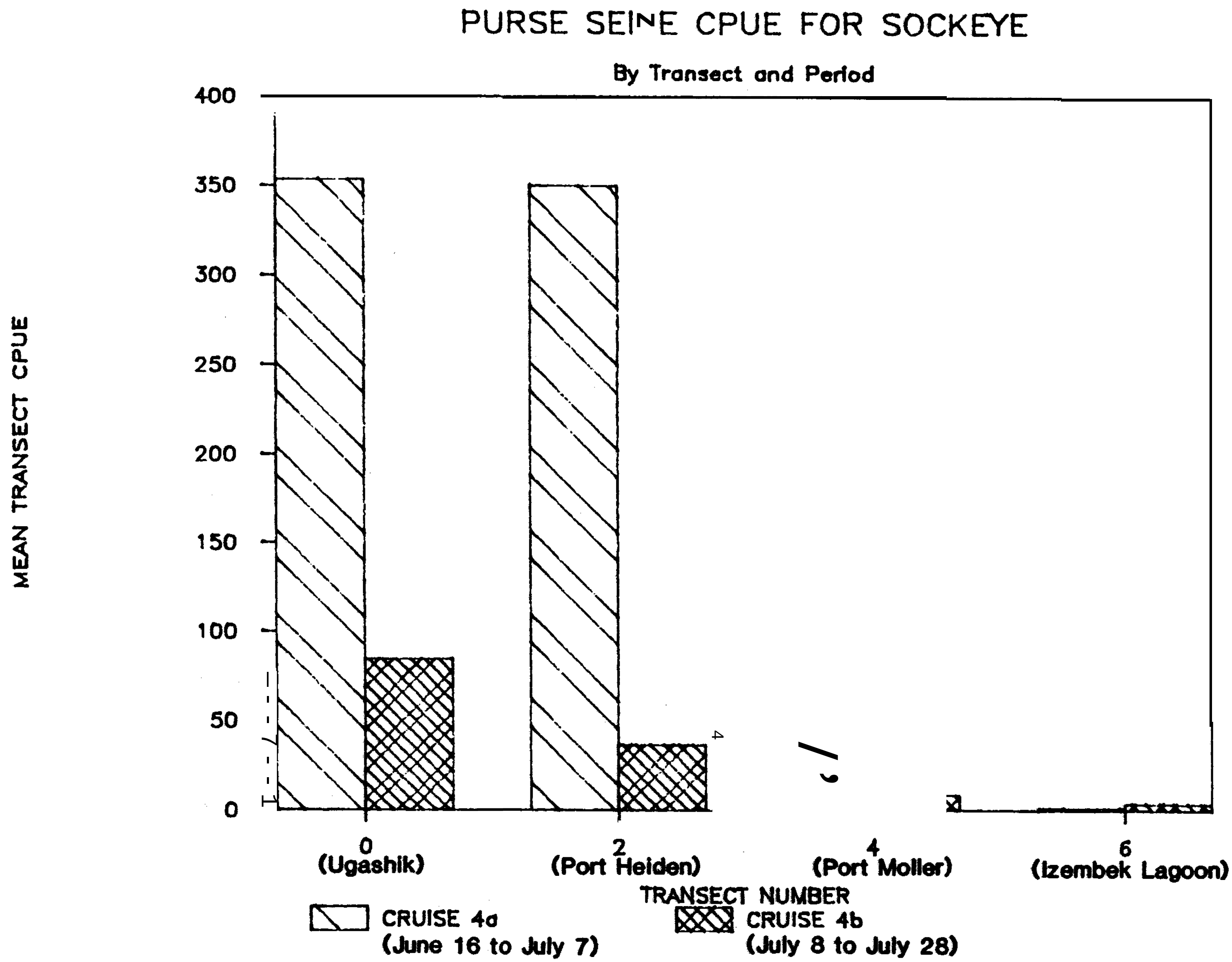
Strong trends in sockeye abundance were apparent in the purse seine catch data (Table 19). Mean CPUE of all sets declined with increasing time and distance from inner Bristol Bay (Figure 27). Highest mean CPUE was recorded in Cruise 4a (June 16 to July 7) at Ugashik, with slightly lower CPUE for sets at Port Heiden 2 days later, and much lower CPUE at Port Moller 3 days hence. Peak CPUE for Port Moller sets was recorded 6 days later on July 2, which may reflect the arrival of early juveniles from inner bay transects. The pattern of CPUE shown in Figure 27 suggests that peak densities of juvenile sockeye had not reached Port Moller by the beginning of sampling on June 16, but were enroute somewhere between there and Port Heiden.

The reconstructed time series of CPUE (Figure 28) was highly correlated with the time series of estimated total sockeye abundance at the Ugashik transect. Mean transect CPUE at each transect was expanded and lagged back in time to the approximate date that fish in the catches would have passed Ugashik. Expansions were based on tag recovery data (Figure 19; also Jaenicke, unpublished data) that showed an exponential decline in tag density with distance from release (Figure 29). Travel times were estimated to be 10 days from Ugashik to Port Heiden, 27 days from Ugashik to Port Moller, and 44 days from Ugashik to Izembek Lagoon, based on an average body length of 9 cm and an assumed average daily swimming speed of 1 b.l./sec (see Section 4.2.7). The resulting pattern of CPUE shown in Figure 28 closely resembles the pattern of daily juvenile abundance at Ugashik calculated by assuming smelts enumerated at the five major river systems migrate at an average swimming speed of 1 b.l./sec (Figure 30).

TABLE 19

SUMMARY OF CRUISE 4 PURSE SEINE CATCHES OF JUVENILE SOCKEYE SALMON

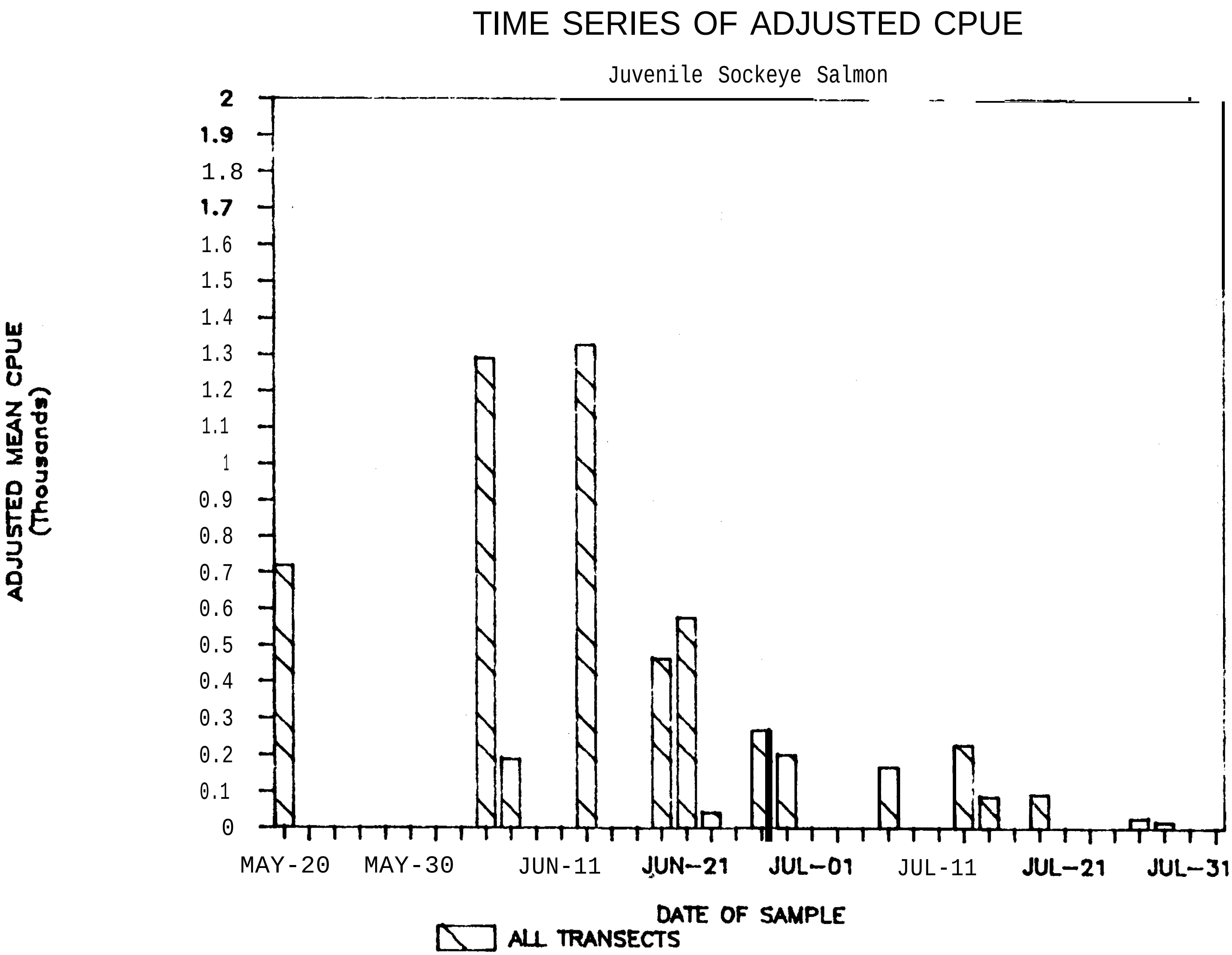
CRUISE	TRANSECT	STATION	NUMBER OF SETS	MEAN CATCH
4 a	UGASHIK	2	3	139.7
		1	3	907.7
		0	3	13.3
	PORT HEIDEN	3	2	296.5
		2	2	734.0
		1	1	40.0
		0	1	0.0
	PORT MOLLER	3	5	21.2
		2	4	52.3
		1	4	45.0
		0	3	52.3
	IZEMBEK LAGOON	3	2	1.5
		2	2	3.5
		1	2	0.0
		0	2	0.0
4b	UGASHIK	2	10	97.3
		1	5	4900
		0	5	96.0
	PORT HEIDEN	3	5	74.6
		2	5	51.6
		1	5	21.6
		0	5	0.0
	PORT MOLLER	3	4	3.8
		2	3	1*4
		1	2	36.1
		0	1	000
	IZEMBEK LAGOON	3	2	0.0
		2	2	13.5
		1	2	0.0
		0	2	0.s



1985 Juvenile Sockeye Catch By Transect and Period

Figure 27

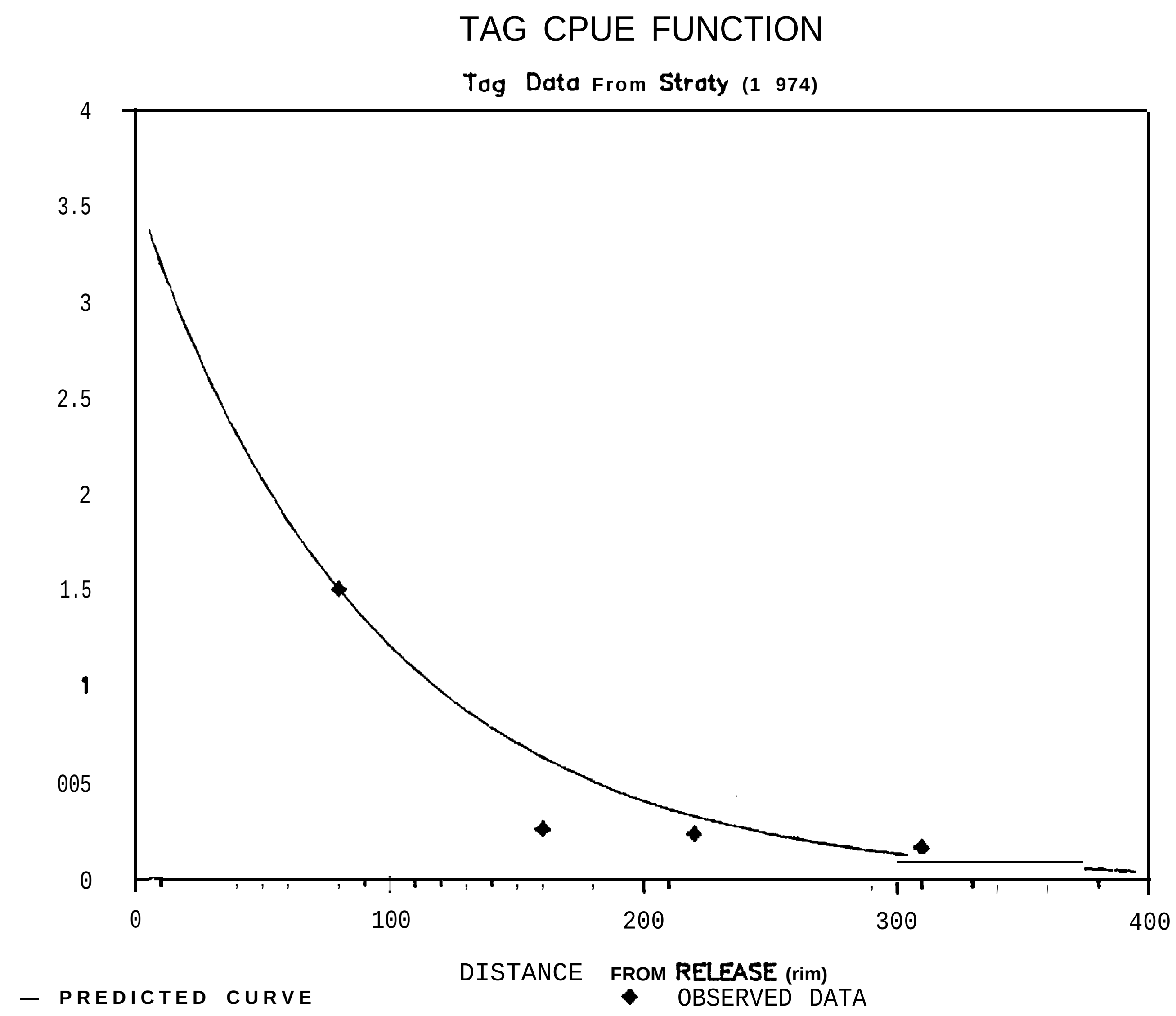
Dames & Moore



Adjusted Transect Catches of Juvenile Sockeye in 1985
Time-Lagged to Date of Passage, Ugashik

Figure 28

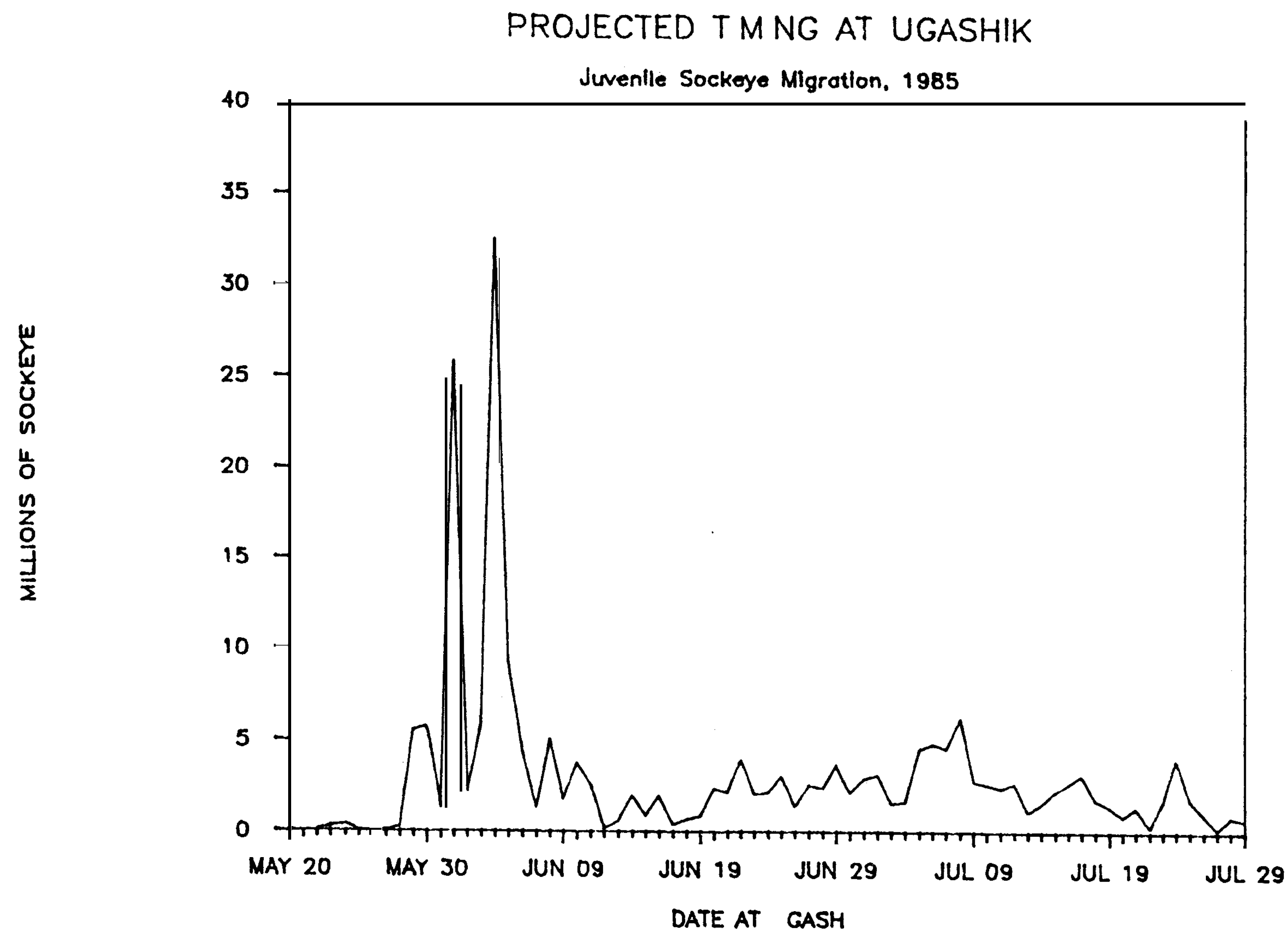
Dames & Moore



Juvenile Sockeye Tag Recovery With Distance From Point of Release

Figure 29

Dames & Moore



Predicted Timing of Juvenile Sockeye Migration at Ugashik in 1985
Based on One Body Length Per Second Swimming Speed.

Dames & Moore

Figure 30

The projection of migration timing above, if reasonably accurate, indicates that peak numbers of juveniles passed Ugashik before our first visit on June 19. Large catches at Port Heiden on June 22 support this conclusion, since distance between the two transects represents about 10 days' travel time for an average-sized juvenile. However, high abundance at Ugashik on May 20, as indicated by the Port Moller catch on June 16, almost certainly is an artifact, since few smelts were enumerated leaving their river systems on that date. The June 16 catch most likely represents a local abundance of Hoodoo Lake or Bear Lake sockeye stocks. The very low CPUE at Izembek Lagoon on June 29 is explained by the fact that the main Bristol Bay juvenile sockeye migration could not have been in the area by that date.

Trends in sockeye catches going offshore were transect-specific. Distributions of CPUE by station are shown for each transect in Figures 31 through 34. The distribution of catches at the Ugashik transect (Figure 31) was influenced heavily in Cruise 4a (June 16 to July 7) by large catches at Station 1 (10 nm offshore) on both June 19 and 20 (1,168 and 1,503, respectively). Cruise 4b (July 8 to 28) catches were relatively evenly distributed offshore. (Recall that Station 3 does not exist at the Ugashik transect.) Trends in abundance offshore were revealed somewhat more clearly at the Port Heiden transect (Figure 32). A definite shoreward bias was described by catches in both cruises; however, the Cruise 4a data were also influenced heavily by a single large catch of some 1,467 juveniles at Station 2 (5 nm offshore). We failed to catch any juvenile sockeye in five sets at Station O on three separate visits to the Port Heiden transect.

Trends in catches at the outer transects (Port Moller and Izembek) were less clearly described than at inner transects (Figures 33 and 34). Cruise 4a catches at Port Moller implied a roughly uniform distribution of sockeye to the offshore limit of the transect, whereas Cruise 4b catches, although greatly reduced in size, were clustered about Station 1 (Figure 33). This general offshore distribution of juveniles at Port Moller contrasted with the strong onshore bias shown at Port Heiden during the same period. Consistently small catches at Izembek Lagoon

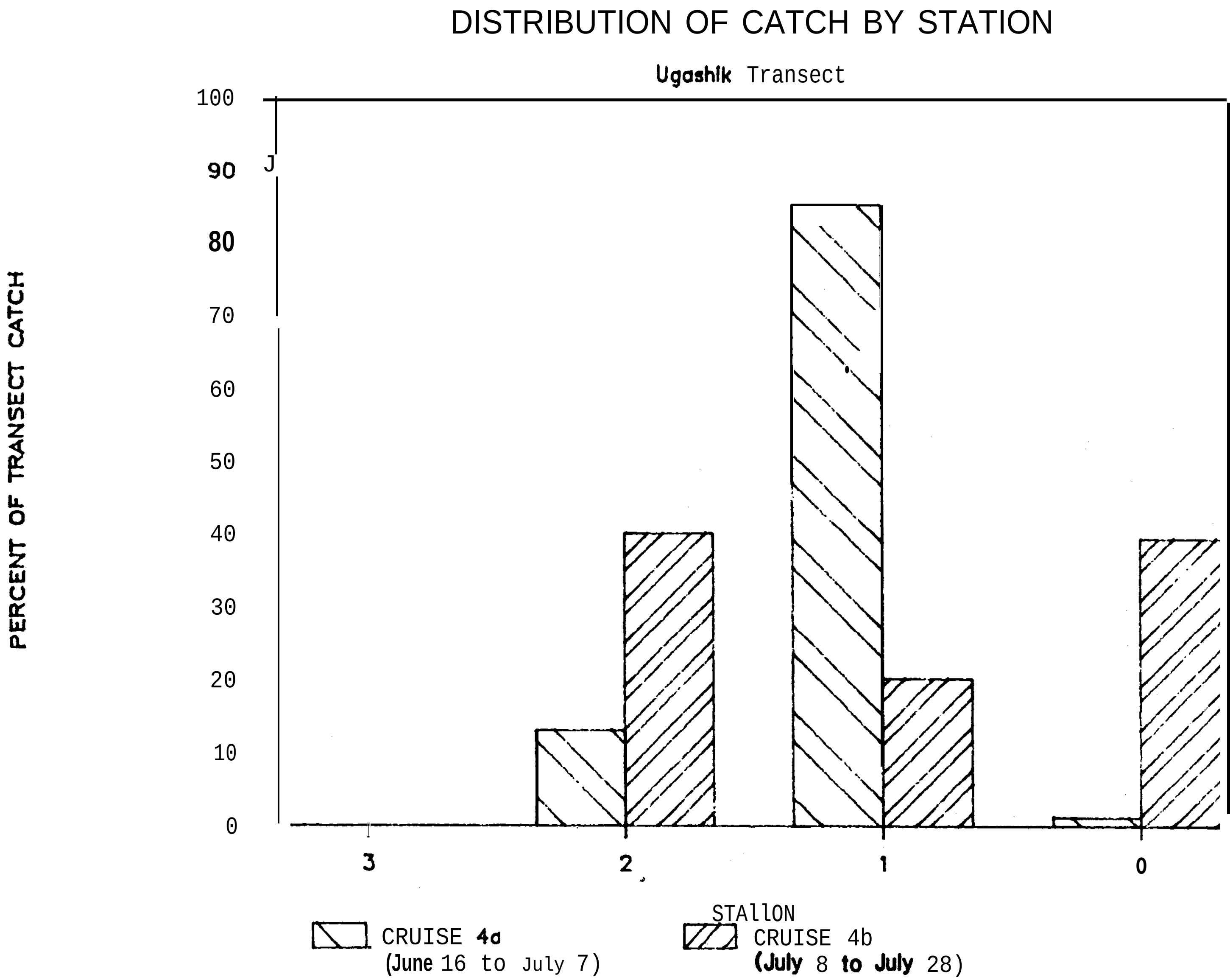


Figure 31

1985 Juvenile Sockeye Purse Seine Catch By Station and Period, Ugashik

Dames & Moore

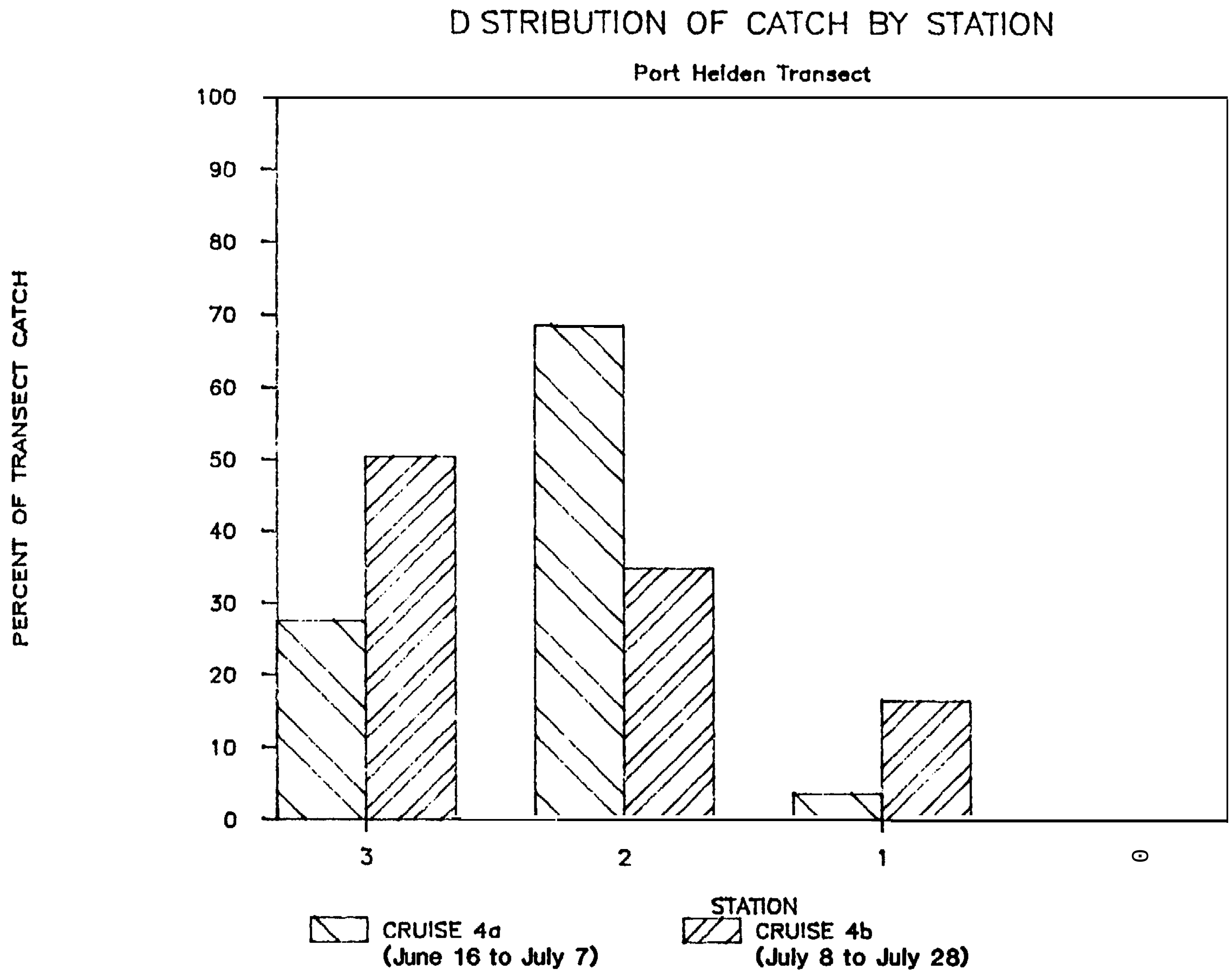
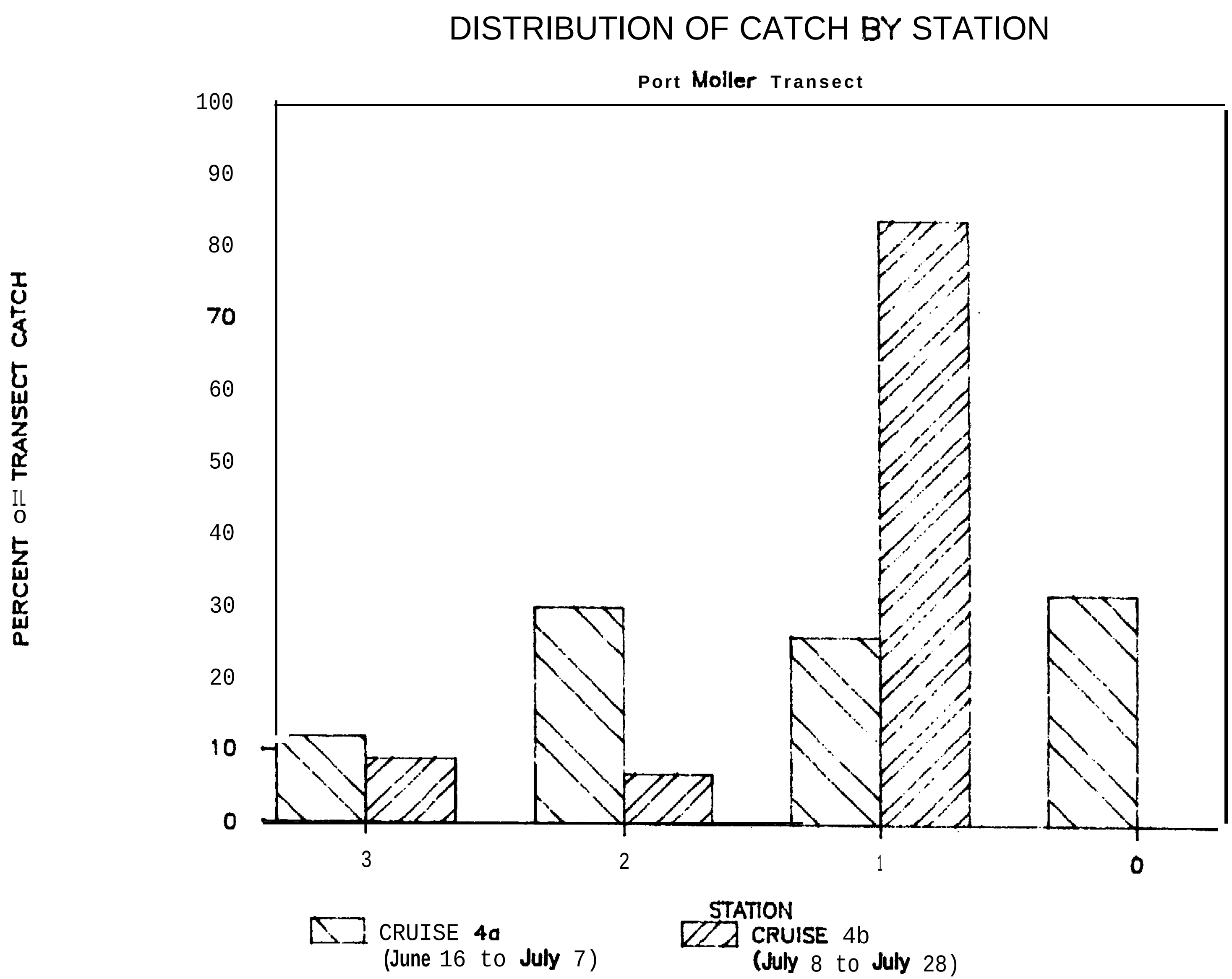


Figure 32

1985 Juvenile Sockeye Purse Seine Catch

By Station and Period, Port Heiden

Dames & Moore



1985 **Juvenile Sockeye Purse Seine Catch By Station and Period, Port Moller**

Figure 33

Dames & Moore

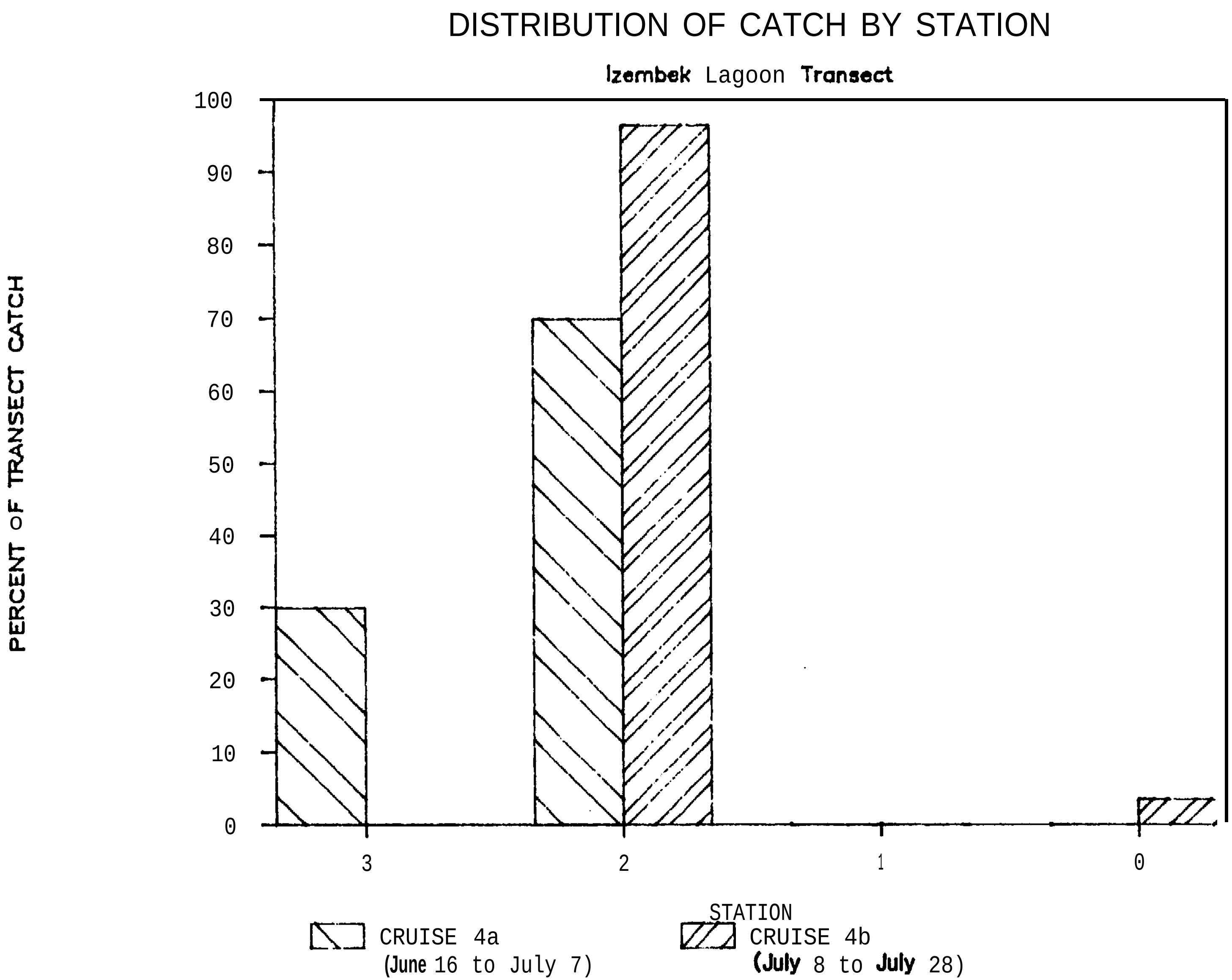


Figure 34 1985 Juvenile Sockeye Purse Seine Catch By Station and Period, Izembek

Dames & Moore

suggested a low-density, patchy distribution of sockeye centered some distance offshore, perhaps outside the transect boundary. We interpret these data to confirm a general offshore movement of sockeye juveniles in the outer bay as proposed by Straty (1974).

Sample mean lengths of juvenile sockeye in purse seine catches displayed no remarkable trends over time or space other than a trend toward increasing mean length with distance down-bay (Figures 35 through 38). Mean lengths in samples taken at Ugashik and Port Heiden generally fell between 90 and 110 mm, while mean lengths of samples taken at Port Moller and Izembek Lagoon fell between about 100 and 130 mm. The hypothesis that juvenile sockeye progressively move offshore with increasing size is not strongly supported by these data (Figures 35 through 38).

4.3.3.2 Chum Salmon

Juvenile chum salmon showed pronounced seasonal and spatial distributions patterns in 1985 (Figure 39). Chum salmon were taken nowhere outside, and only intertidally inside,the Port Moller estuary in Cruise 4a (June 16 to July 7), but they were present in all gear at all locations in Cruise 4b (July 8 to 29). Chum abundance declined from inner Bay to outer Bay transects (Table 20). The density of juvenile chums evidenced by catches at Port Moller emphasizes the importance of this estuary as a nursery for local stocks.

A temporal shift in habitat use which has been documented elsewhere for juvenile chum (Bax, et al. 1980; Simenstad, et al. 1982) is clearly displayed in Figure 39. The relationship between beach seine CPUE and small seine CPUE in the first and second survey periods at Port Moller suggested a size-dependent movement of chum fry out of intertidal habitats. However, variability in our size data for juvenile chum masked significant differences in mean size of fish in beach seine and small seine samples.

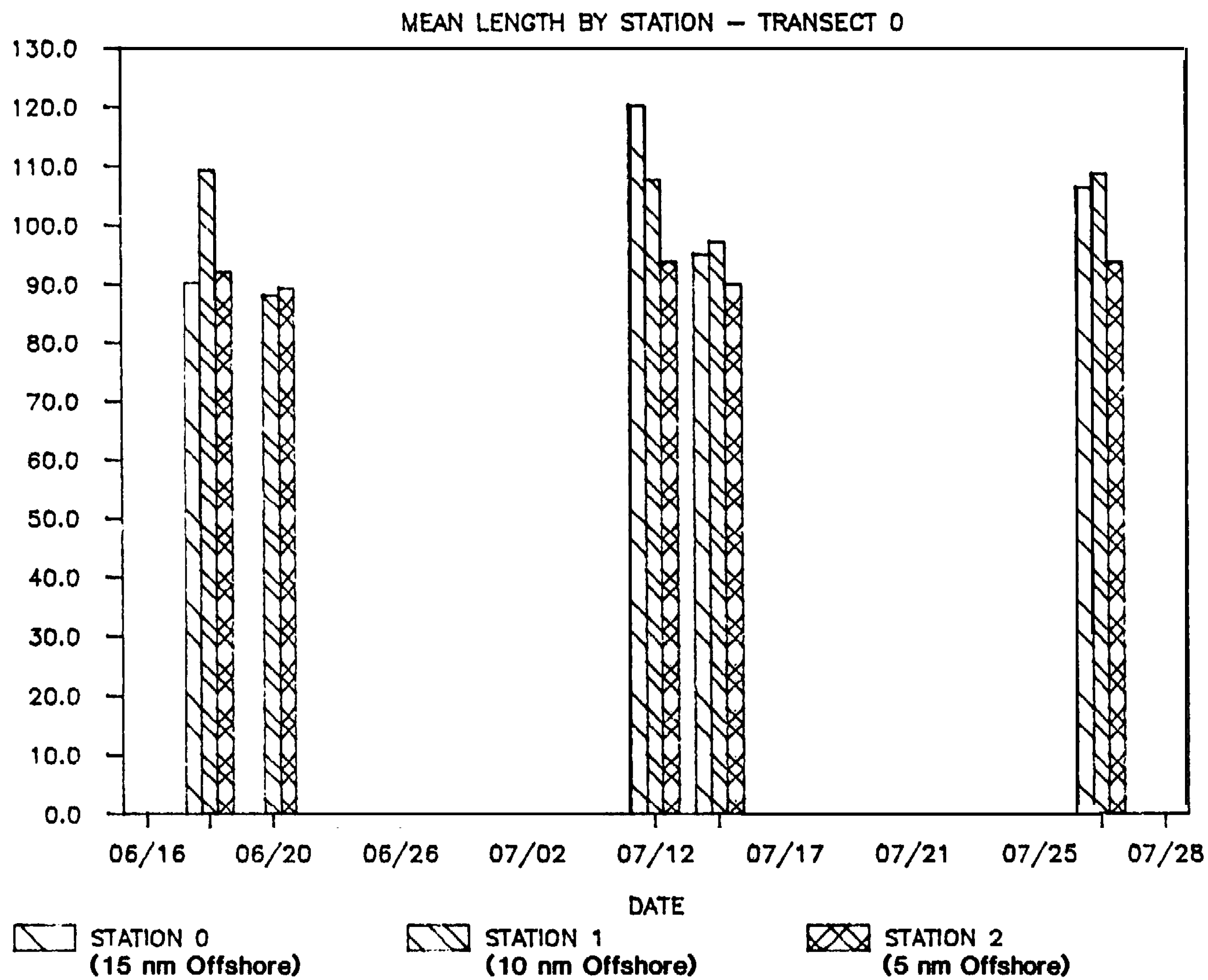
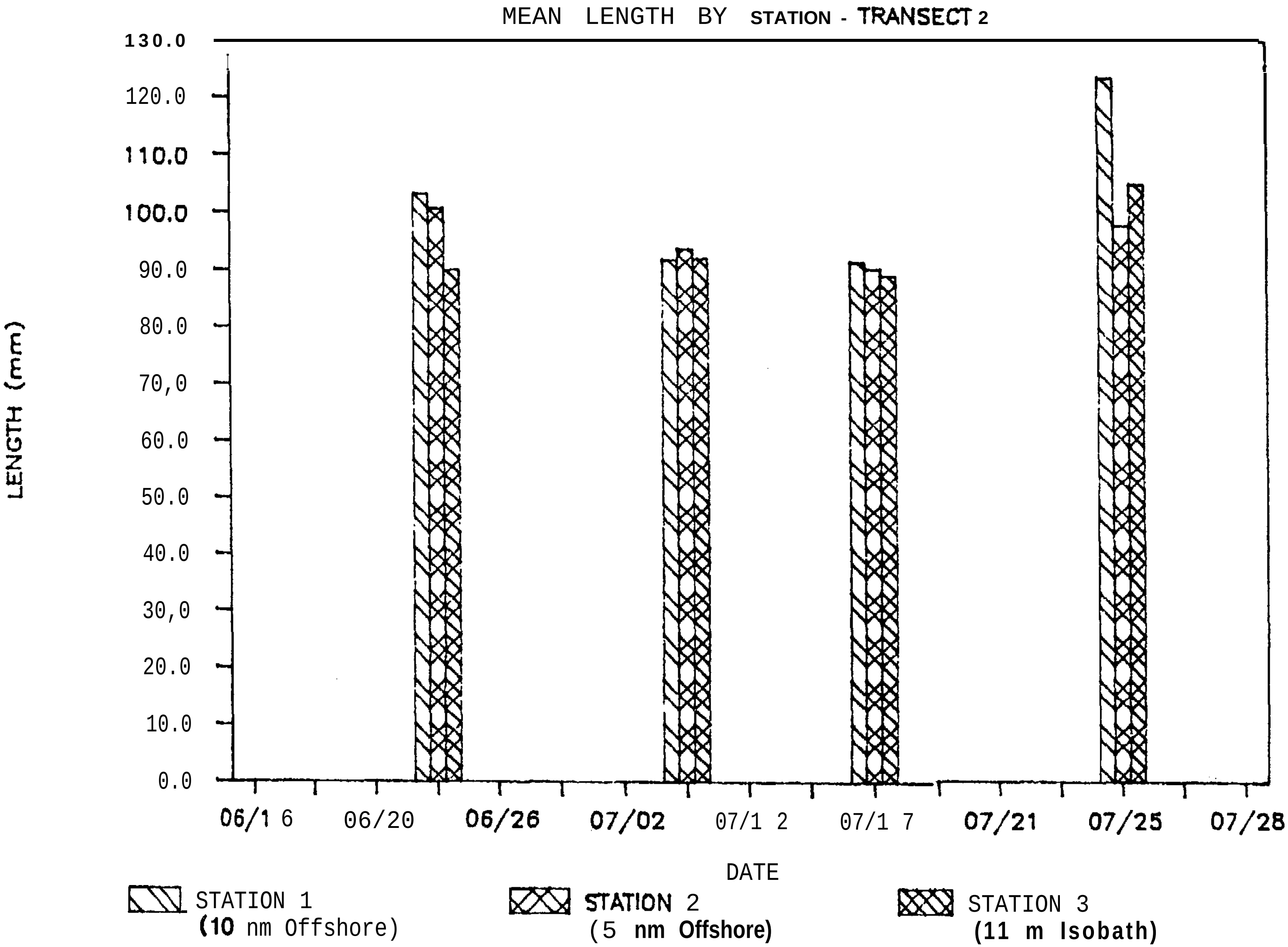


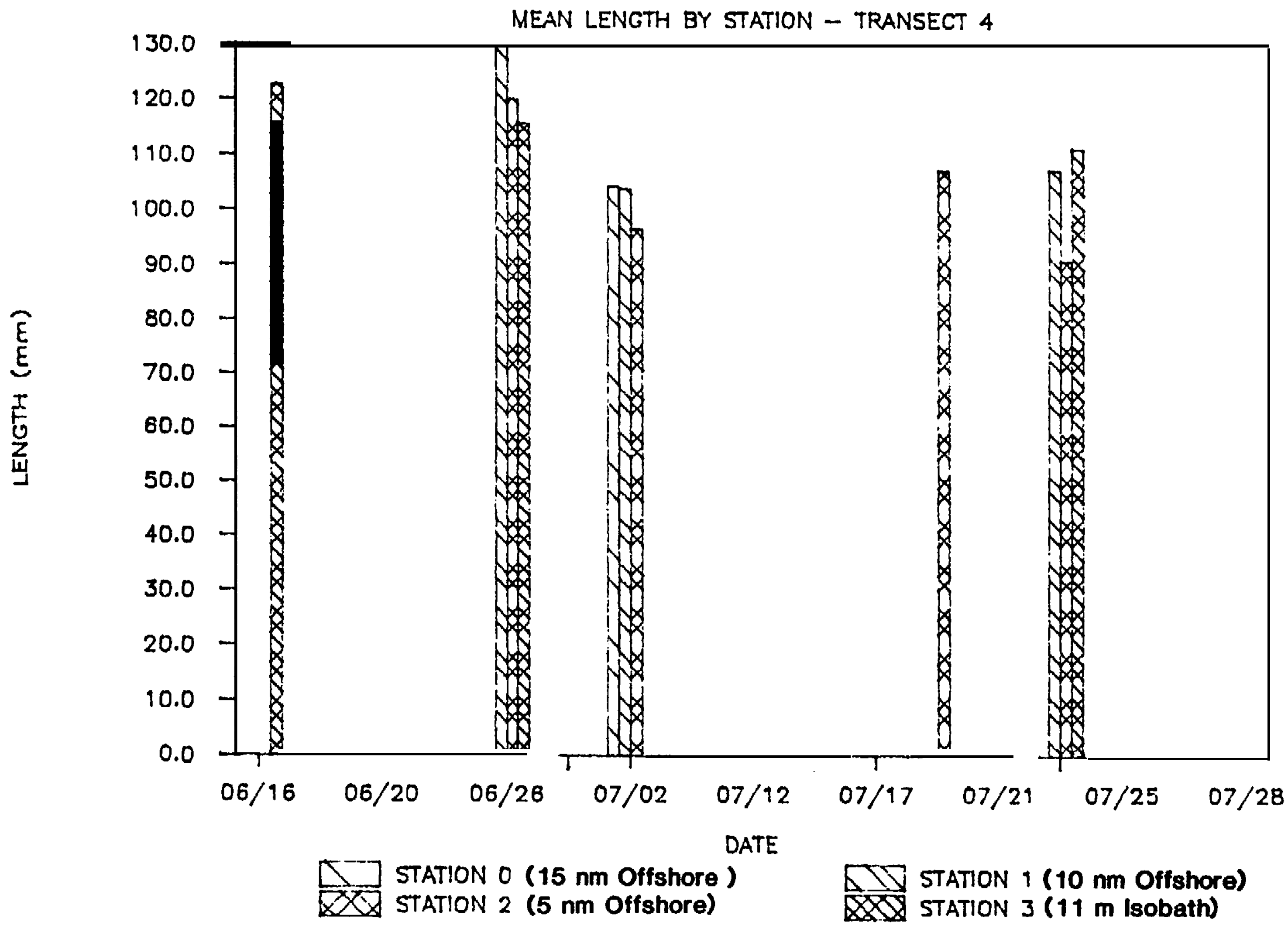
Figure 35

Mean Lengths of Juvenile Sockeye in 1985 Purse Seine Catch by Station, Ugashik.

Dames & Moore



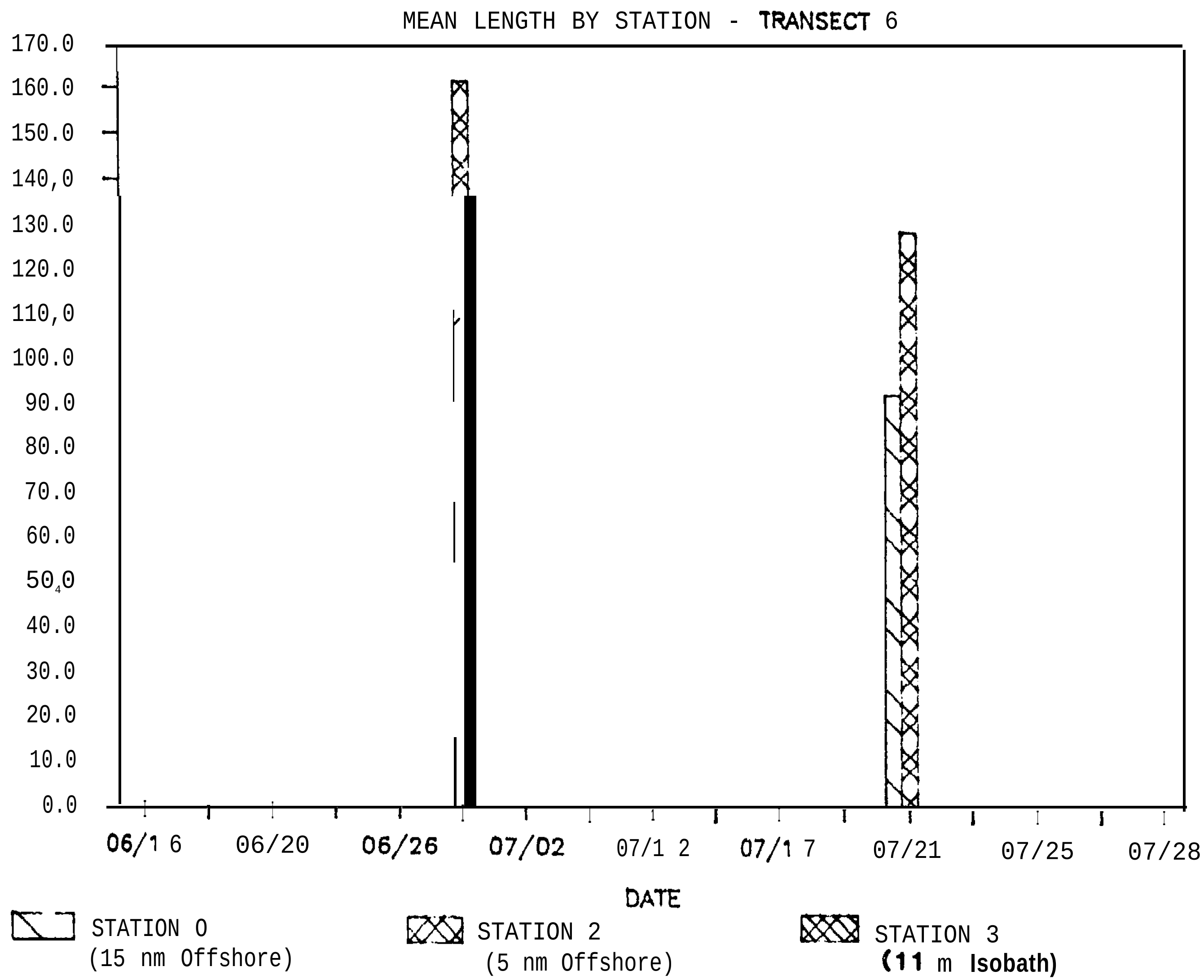
Mean Lengths of Juvenile Sockeye in 1985
Purse Seine Catch by Station, Port Heiden



Mean Lengths of Juvenile Sockeye in 1985
Purse Seine Catch by Station, Port Moller.

Figure 37

Dames & Moore



Mean Lengths of Juvenile Sockeye in 1985 Purse Purse Seine Catch by Station, Izembek.

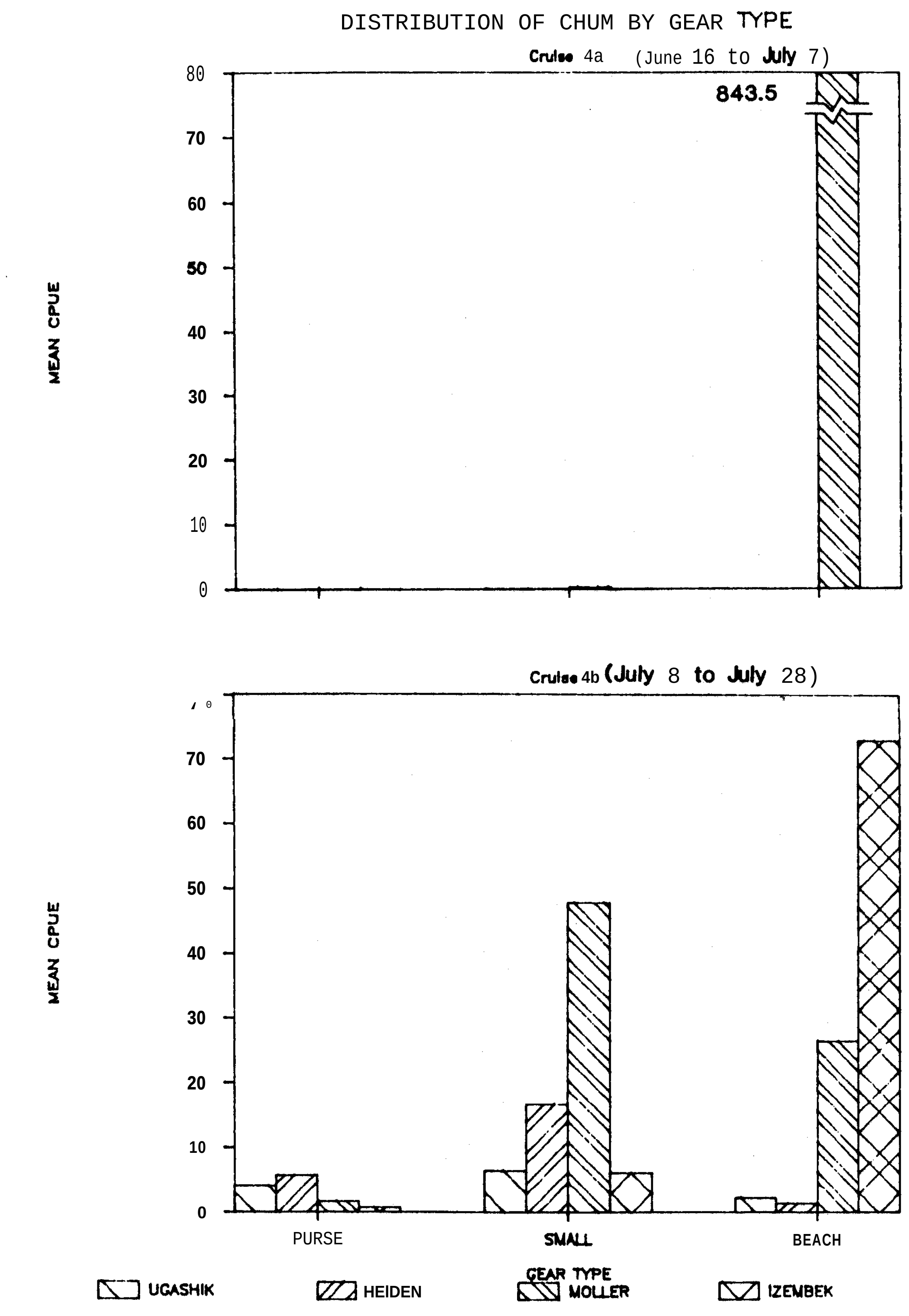
Figure 38

Dames & Moore

TABLE 20

SUMMARY OF JUVENILE NON-SOCKEYE SALMON CPUE BY GEAR TYPE AND PERIOD AT EACH TRANSECT

SPECIES	TRANSECT	CRUISE 4a (June 16- July 7) PURSE SEINE	SMALL SEINE	BEACH SEINE	CRUISE 4b (July 8- 28) PURSE SEINE	SMALL SEINE	BEACH SEINE	GEAR POOLED
COHO	UGASHIK	.7	0.0	0.0	2.9	0.0	0.0	0.6
	PT. HEIDEN	0.3	0.0	0.0	6.0	0.0	0.s	1.2
	PT. MOLLER	3.4	2.7	4.6	2.2	2.0	0.7	2.6
	IZEMBEK	0.0	0.0	0.0	0.7	2.3	3*5	1.1
CHUM	UGASHIK	0.0			4.2	6.5	2.3	3.3
	PT. HEIDEN	0.0	0.0		5.8	16.7	0.8	2.9
	PT. MOLLER	0.0	0.3	043.5	0.0	47.9	26.5	153.0
	IZEMBEK	0.0			0.8	6.2	73.0	20.0
PINK	UGASHIK	0.0			0.6	0.0	0.0	0.2
	PT. HEIDEN	0.0	0.0		0.0	0.0	0.0	0.0
	PT. MOLLER	0.0	0.0	179.1	0.3	12.9	3.8	32.7
	IZEMBEK	0.0			0.0	0.0	0.0	0.0



1985 Juvenile Chum Catch By Gear Type

Dames & Moore

Figure 39

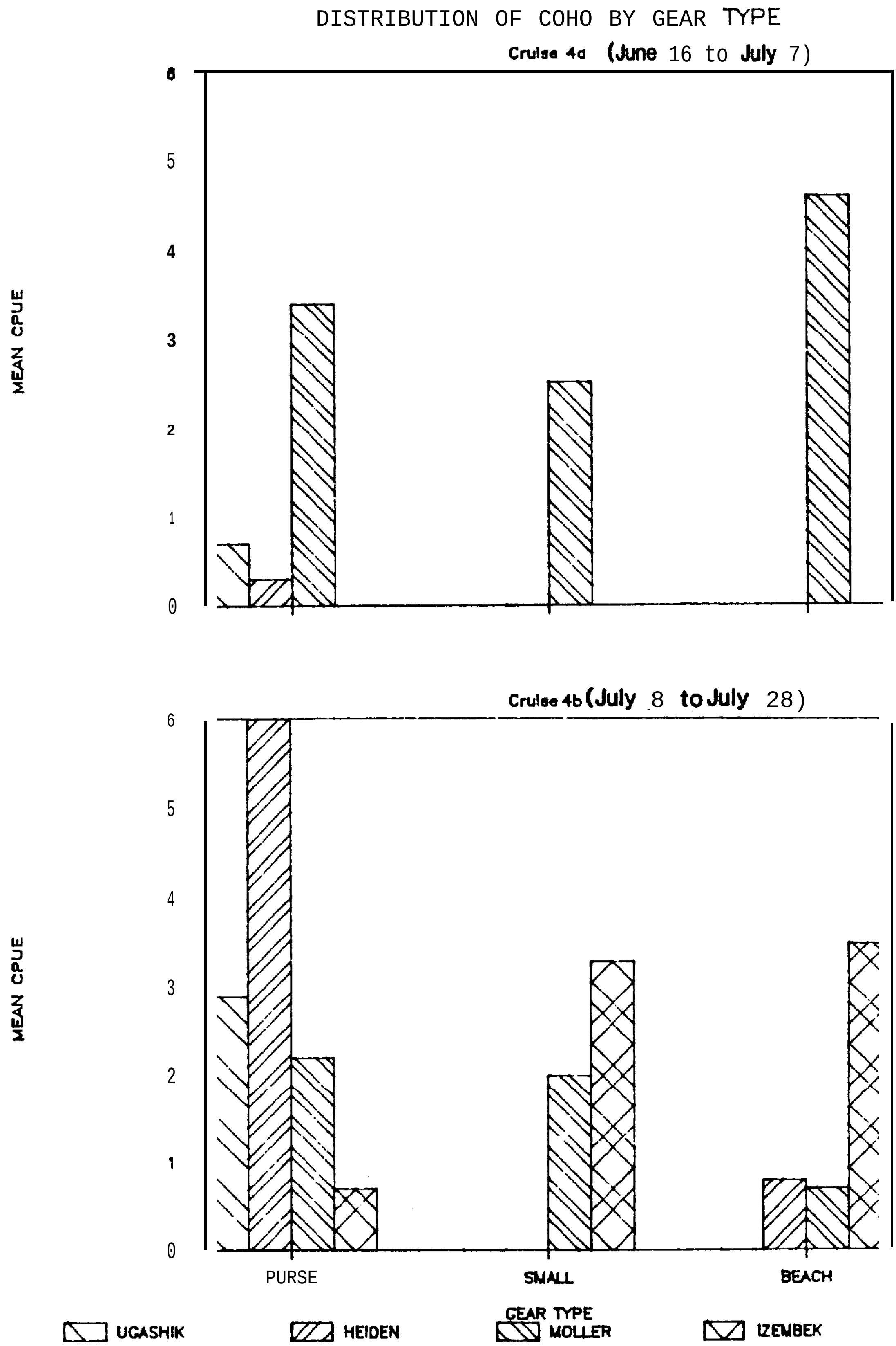
The appearance of juvenile chum in large and small seine catches at all locations late in the survey (Cruise 4b) marked a directed migration of juveniles to estuarine habitats and the nearshore neritic zone. Chum were distributed essentially within 5 nm of shore, as only 0.6 percent of all chum taken in the large purse seine were captured farther offshore. Juvenile chum had by this time become comparable in body size to the 2- and 3-year old juvenile sockeye taken coincidentally with them. Because the purse seine CPUE of chum was increasing at the end of sampling activities, we conclude that the offshore movement of juveniles was incompletely documented during the survey period.

4.3.3.3 Coho Salmon

The pattern of catches of juvenile coho salmon by all gear suggests that they were not present in estuarine habitats of Ugashik Bay or Port Heiden, but did use such habitats inside Port Moller and Izembek Lagoon. Further, their distribution offshore was strongly biased shoreward and was temporally variable.

Juvenile coho were uniformly distributed in relatively low abundance between estuarine and very nearshore intertidal and subtidal habitats over the 1985 survey period. Over 70 percent of all coho were taken within 3.5 nm of shore, and none was caught offshore of 5.0 nm. Mean CPUE for juvenile coho was 1.9, 1.6, and 1.6 fish\set for the large seine, small seine, and beach seine, respectively. Of the total catch of coho by all gear , about 11 percent was taken at Ugashik, 22 percent at Port Heiden, 47 percent at Port Moller, and 20 percent at Izembek Lagoon (Table 20).

With the exception of the Port Moller transect, catches generally increased with time at all transects with all gear (Figure 40). Juvenile coho were virtually absent inside Ugashik Bay and Port Heiden at all times. The increase in purse seine CPUE over time at these transects probably reflected the arrival of juveniles from inner Bristol Bay rivers. The stability of catches over time in and near Port Moller implies that juvenile coho remain in this estuary for extended periods.



1985 Juvenile Coho Catch By Gear Type

Dames & Moore

Figure 40

Catches of coho at the Port Moller transect suggest a trend of movement out of intertidal habitats with time. Highest mean CPUE was obtained in the beach seine in Cruise 4a, but this trend reversed in Cruise 4b with larger catches in the small and large purse seine. Movement offshore probably is a size-dependent rather than a time-dependent process. The mean weight of coho taken in beach seine sets was significantly lower than that for coho taken in the small seine or purse seine (17.4 grams vs 49.8 and 55.5, respectively; P <.001), indicating that coho obtained additional growth inside Port Moller before moving to the open coastline. We interpret these data to confirm the suggestion that Port Moller serves an important function as a secondary rearing area for juvenile coho.

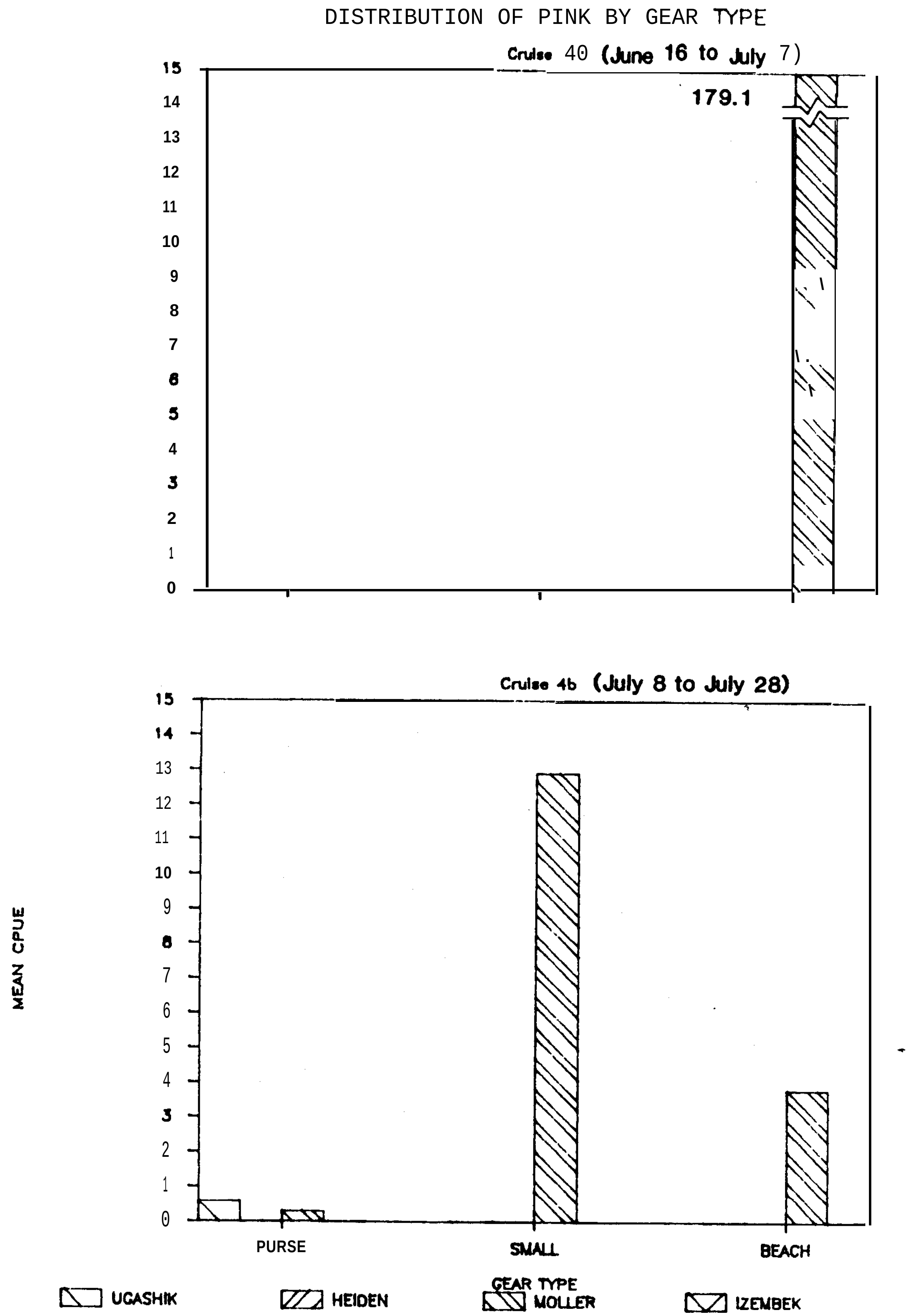
4.3.3.4 Chinook Salmon

The six juvenile chinook salmon caught in 1985 were equally distributed between each of the three gear types. Four of the six individuals were taken from mid- to late July inside or near the mouth of Ugashik Bay, to which a sizeable run of adult chinook returns annually. The other fish were taken by purse seine off Port Moller on June 16 and by beach seine inside Port Heiden on July 25.

Straty (NMFS, Juneau, personal communication 1986) suggests that poor catches of juvenile chinook in the study area may not accurately depict the relative numbers of this species in the study area. Studies in southeast Alaska have found that juvenile chinook tend to migrate earlier and travel in deeper water than do juveniles of other species. Therefore, juvenile chinook may have been out of the study area before sampling began or in deeper water inaccessible to the purse seines.

4.3.3.5 Pink Salmon

Juvenile pink salmon were not widely distributed in the study area during the 1985 survey period (Table 20). No pink juveniles were taken at any transect other than Port Moller, except for several taken in the large purse seine on the last 2 days of sampling at Ugashik (Figure 41).



1985 Juvenile Pink Catch By Gear Type

Dames & Moore

Figure 41

Within the Port Moller estuary, the pattern of habitat use by pink salmon was very similar to that of chum salmon. Figure 41 traces a shift away from intertidal habitats in Cruise 4a to open-water estuarine and offshore habitats in Cruise 4b. A complete image of the ultimate movement of pinks to the open water probably was truncated by cessation of the survey.

The abundance of pink fry should have been relatively high in 1985 after the even-year adult return to Bristol Bay rivers in 1984. Our failure to find evidence of them in bays and estuaries or near shore throughout the survey indicates that local production of pink salmon in the study area is negligible outside of Port Moller. The abundance of pinks offshore is not accurately depicted by 1985 purse seine catches because sampling was terminated before the bulk of juveniles migrating from Bristol Bay spawning grounds could have reached the study area.

4.3.3.6 Sockeye Salmon Scale Pattern Analysis

Analysis of scales collected in 1985 from juvenile sockeye captured at Ugashik and Port Heiden produced poor estimates of the stock composition. Growth patterns in scales of Ugashik, Naknek, and Wood River sockeye were virtually indistinguishable, whereas those in scales of Egegik and Kvichak sockeye were distinct from the other stocks. Several techniques employed to enhance the low intrinsic separability of Ugashik, Naknek, and Wood River scales are described in detail below.

A total of 1,415 scales from juvenile sockeye salmon was examined for the scale pattern analysis. Training samples (hereafter called "standards") from each of the five river systems in the analysis totalled 989 scales, and the remaining 426 scales were of unknown origin (hereafter called "unknowns") sampled at the Ugashik and Port Heiden transects between June 19 and July 28. Eighteen of the unknowns were determined to be unreadable and were excluded. Age analysis of the remaining scales revealed that over 78 percent of captured sockeye were age I and less than 22 percent were age II migrants. Sample size considerations consequently limited the scale pattern analysis to age I scales.

Location and date of capture of unknown samples are summarized in Table 21. Sample sizes generally were small owing to the post hoc nature of the scale study. Samples of unknowns were pooled to transect level to obtain adequate sample sizes for each location. Some samples taken on adjacent dates, such as on June 19 to 20 and on July 27 to 28, were pooled for the same reason.

Standard samples were assembled from scales collected by ADF&G during smolt enumeration projects on each of the major Bristol Bay river systems in 1985. Approximately 200 scales were subsampled from all time segments of the smelt outmigration at each river system in proportion to smelt abundance during the time period in which scales had been collected.

A total of 11 scale features was defined from summary scale measurement data and 3 more were added by transformation (Table 22). However, scale characters beyond the first freshwater annulus were not permitted to enter the analysis, because the inability to distinguish lacustrine “plus growth” from early ocean growth on the scales would bias the classification of unknowns. Summarized scale measurement data for each standard and the unknown samples were submitted to a stepwise linear discriminant function (LOF) analysis (BMDP7M) for initial screening and estimation of classification accuracies.

Initial runs of the discriminant analysis included all standards and unknowns, no assignment of prior probabilities, and unconstrained stepping through the scale character set. Results of these runs provided a first assessment of the set of significant scale characters and estimates of classification accuracy of the discriminant function with inclusion of each variable.

The classification matrix for a five-class discriminant function under conditions as stated above showed weak recognition of Ugashik, Naknek, and Wood River stocks, and strong recognition of Egegik and Kvichak stocks (Table 23). Frequency distributions of the two most significant allowable scale characters illustrated the reasons for poor classification accuracy in the five-class analysis (Figure 42).

TABLE 21

LOCATION AND DATE OF CAPTURE
OF SCALES IN UNKNOWN SAMPLES

Sample Date	Location	Number
6/19-20	Ugashik	9
6/22	Port Heiden	42
7/8	Port Heiden	38
7/12	Ugashik	39
7/14	Ugashik	45
7/17	Port Heiden	72
7/2S	Port Heiden	47
7/27-20	Ugashik	17

TABLE 22

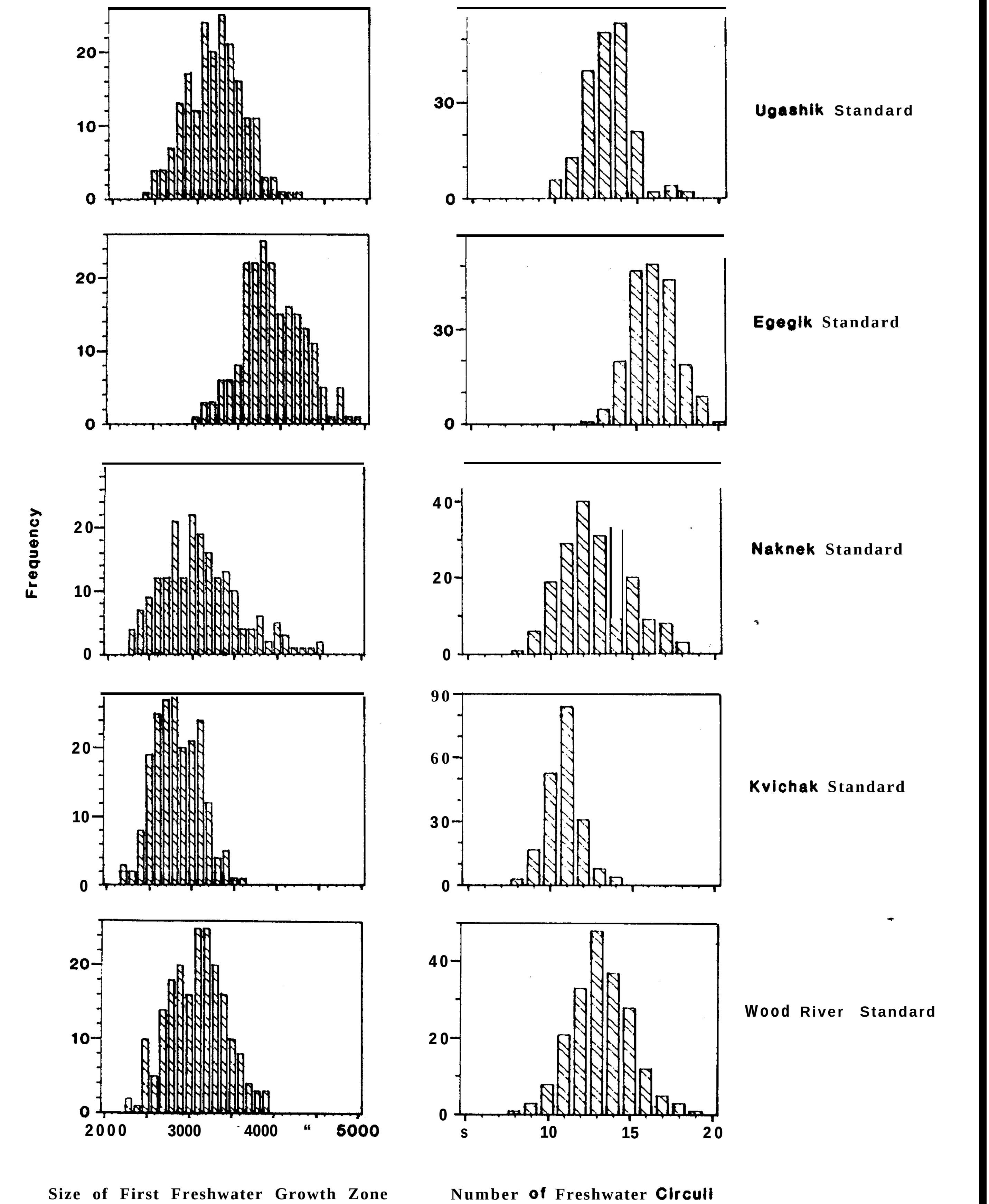
LIST OF SCALE CHARACTERS SUBMITTED TO
STEPWISE DISCRIMINANT FUNCTION ANALYSIS

VARIABLE	CODE	VARIABLE DESCRIPTION
NCIRC	3	TOTAL NUMBER OF CIRCULI
INRAD	4	SIZE OF SCALE FOCUS
AFWCRC	5	NUMBER OF CIRCULI IN FRESHWATER ZONE 1
AFWSZ	6	SIZE OF FRESHWATER ZONE 1
TRIPA	7	DISTANCE FROM 1ST TO 4TH CIRCULUS
TRIPB	8	DISTANCE FROM 4TH TO 7TH CIRCULUS
TRIPC	9	DISTANCE FROM 7TH TO 10TH CIRCULUS
TRIPD	10	DISTANCE FROM 10TH TO 13TH CIRCULUS
TRIPE	11	DISTANCE FROM 13TH TO 16TH CIRCULUS
PLCRC	12	NUMBER OF PLUS GROWTH CIRCULI
PLSZ	13	SIZE OF PLUS GROWTH ZONE
ADDED BY TRANSFORMATION:		
TOTSZ	14	TOTAL SIZE OF SCALE
PRESD	15	PRESENCE OR ABSENCE OF TRIPD
PRESE	16	PRESENCE OR ABSENCE OF TRIPE

TABLE 23

CLASSIFICATION MATRIX FOR A 5-CLASS DISCRIMINANT FUNCTION WITH
NO PRIOR PROBABILITIES AND STEPPING LIMITED BY MINIMUM F-TO-ENTER CRITERIA

GROUP	PERCENT CORRECT DECISIONS	NUMBER OF DECISIONS				
		UGASHIK	EGEGIK	NAKNEK	KVICHAK	WOOD RIVER
UGASHIK	55.5	111	10	26	26	27
EGEGIK	73.6	35	148	7	0	11
NAKNEK	55.3	22	16	110	17	34
KVICHAK	63.1	12	1	9	157	10
WOOD RIVER	55.2	30	10	25	25	111
MEAN	64.3					



Distribution of Two Characters in 1985 Scale Standards

Figure 42

Comparisons of circulus number and total size of the freshwater scale growth zone clearly showed broad overlap in the distributions of Ugashik, Naknek, and Wood River standards, while those of Egegik and Kvichak standards were somewhat displaced from the others. Note that these scale characters displayed the highest degree of stock-specificity of all characters in the data set.

Alternative classification schemes were devised to enhance the minimal differences between scale patterns. For example, a set of prior probabilities of stock assignment was imposed on the classification of unknowns based on the relative abundances of age I smelts contributed by each stock to the bay-wide smelt migration in 1985. However, since this procedure failed to significantly improve overall classification accuracy and carried the implicit, probably unrealistic? assumption that juveniles of all stocks were equally vulnerable to capture at all times, assignment of prior probabilities was dropped from subsequent analyses.

Another approach taken to mitigate the effect of poor separability of Ugashik, Naknek, and Wood River stocks was simply to exclude one or more of these standards from the classification of unknowns. We assumed, based on smelt outmigration timing and distance to the study area, that Wood River sockeye were not in the vicinity of Ugashik or Port Heiden on the first sampling dates at those transects and, further, that Ugashik fish likely had migrated out of the area by the second and subsequent visits. Accordingly, the Wood River standard was excluded from the classification of unknowns sampled on June 19 to 20 at Ugashik and on June 22 at Port Heiden, and the Ugashik standard was excluded from the classification of unknowns sampled thereafter (Table 24).

Separate linear discriminant functions were developed for the classification schemes described above. The results of stepwise variable selection indicated that a single scale character (number of lacustrine circuli) provided maximum accuracy in classification of unknowns sampled on June 19 to 20 and June 22 (Wood River excluded), whereas a set of 5 characters was warranted in the classification of remaining unknown samples (Ugashik excluded). Overall classification

TABLE 24

CORRECTED ESTIMATES (+/- 80% CONFIDENCE LIMIT) OF PERCENTAGES OF EACH STOCK PRESENT IN SAMPLES COLLECTED AT UGASHIK AND PORT HEIDEN

DATE	TRANSECT		STOCK				
			UGASHIK	EGEGIK	NAKNEK	KVICHAK	WOOD RIVER
6/19-20	UGASHIK	z	0.0	0.0	100.0	0.0	N/A
	n = 9	+/-	419.0	82.9	759.0	258.0	---
6/22	PT. HEIDEN	z	13.8	0.0	0.0	86.2	N/A
	n = 42	+/-	91.6	18.3	162.2	55.6	---
7/%	PT. HEIDEN	z	N/A	0.0	0.0	42.3	57.6
	n = 38	+/-	---	7.4	72.3	33.2	53.9
7/12	UGASHIK	%	N/A	0.0	100*O	0.0	0.0
	n = 39	+/-	---	16.7	95.6	37.4	60.7
7/14	UGASHIK	z	N/A	1.3	78.1	7.4	13.2
	n = 45	+/-	---	16.5	03.0	32.2	55.0
7/17	PT. HEIDEN	%	N/A	0.0	95.2	4.8	0.0
	n = 74	+/-	---	10.6	78.3	31.0	49.8
7/25	PT. HEIDEN	%	N/A	0.0	65.1	27.4	7.5
	n = 47	+/-	---	13.8	83.5	35.1	52.3
7/27-28	UGASHIK	%	N/A	9.5	20.1	54.1	16.3
	n = 17	+/-	---	23.9	103.0	49.5	65.9

accuracy for the Wood River-excluded LDF was 60.3 percent, and that for the Ugashik-excluded LDF was 64.3 percent.

The matrix correction procedure given in Cook (1982) was used to adjust estimates of proportions of each stock present in unknown samples to account for misclassification error. Resulting corrected estimates (± 80 percent confidence limit) of stock mixing proportions are summarized for the classification of unknown samples in Table 24 and are expanded in Table 25 to estimates of relative numbers of each stock present in total transect catches. These results indicate that Naknek stock predominated in virtually all juvenile sockeye catches at Ugashik and Port Heiden in both Cruise 4a and 4b. Given the broad confidence intervals about the proportional estimates, there is little point in carrying the discussion further. It is noteworthy, however, that the absence of Ugashik and Egegik sockeye from most samples is consistent with results obtained when a migration rate of 1 b.l./sec. was applied to the time and distance of migration from rivers of origin.

To summarize, the similarity of scale growth patterns for three of the five major Bristol Bay stocks precluded successful stock identification in samples of sockeye salmon juveniles captured at the Ugashik and Port Heiden transects using scale patterns and a linear discriminant function analysis. Plots of the frequency distributions of significant scale measurements revealed substantial overlap in those for Ugashik, Naknek, and Wood River stocks, while those for Egegik and Kvichak stocks were somewhat displaced. Results suggest that Naknek sockeye juveniles predominated in catches throughout the survey period, but the precision of estimates of stock mixing proportions permits no reliable conclusions. It should be noted that the 1985 smelts from Wood River were unusually large (second largest since 1954) for that system. In most years, the typically small Wood River smelts probably could be separated from the other systems by scale measurements.

TABLE 25

ESTIMATED NUMBERS OF SOCKEYE OF EACH BRISTOL BAY STOCK
IN CATCHES AT UGASHIK AND PORT HEIDEN DURING CRUISE 4

DATE	TRANSECT	CATCH	STOCK: UGASHIK	EGEGIK	NAKNEK	KVICHAK	WOOD RIVER
6/19-20	UGASHIK	3182	0	0	3182	0	0
6/22	PT. HEIDEN	2101	290	0	0	1811	0
7/8	PT. HEIDEN	260	0	0	0	110	150
7/12	UGASHIK	1145	0	0	1145	0	0
7/14	UGASHIK	268	0	4	209	20	35
7/17	PT. HEIDEN	317	0	0	302	15	0
7/25	PT. HEIDEN	163	0	0	106	45	12
7/27-20	UGASHIK	283	0	27	57	153	46
	TOTAL	7719	290	31	5001	2154	243

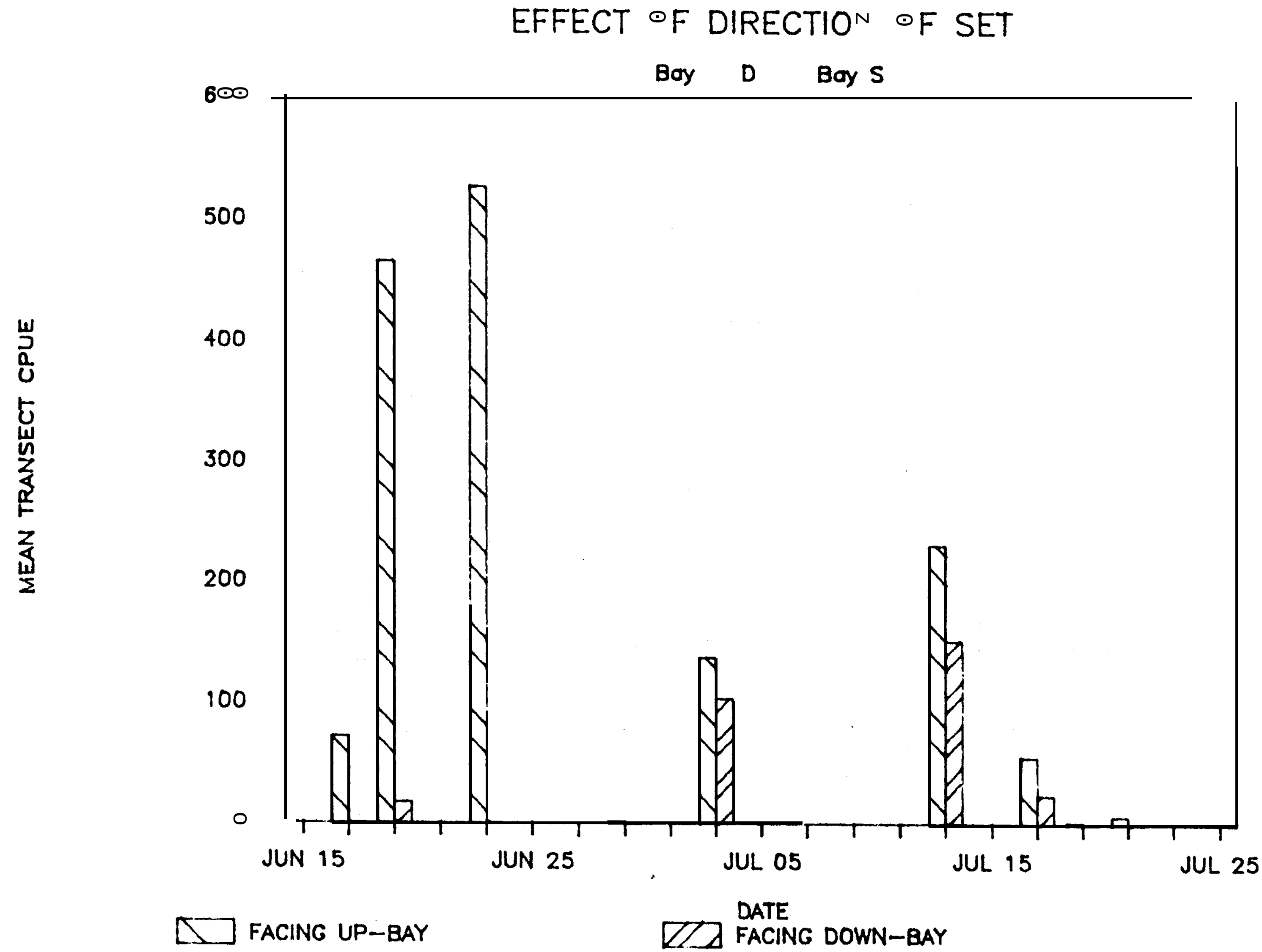
4.3.4 Discussion of 1985 Juvenile Salmonid Catches

The obvious problem in assigning some significance to the juvenile salmon catch data is in determining how much of an observed trend is real and how much is the product of sampling error. We assumed that the major source of variability in catches would be the spatial and temporal differences in the density of juvenile salmon encountering the purse seine -in other words, real trends. However, we assumed as well that other factors related to the distributional characteristics of out-migrants could also influence the probability of their encountering the net. We tested specifically for variability in catch due to direction of set, tide stage, and schooling of juvenile sockeye.

The strong directional component of the sockeye migration was clearly displayed in comparisons of catches from back-to-back purse seine sets at several stations. Catches in sets facing toward inner Bristol Bay consistently were higher than companion sets facing outward, irrespective of tide stage (Figure 43). It is clear, therefore, that the direction of set must be taken into consideration when catches are compared between locations, dates, or years.

We also found evidence that tide stage may secondarily affect the number of fish caught. Sockeye catches from paired experimental sets facing down-bay at Port Moller on June 26 were significantly smaller during the flood than during the ebb (Table 26). Paired experimental sets facing up-bay at Port Moller on July 23 also revealed the presence of substantial numbers of juvenile sockeye offshore on the ebb and an absence of fish offshore during the flood. Paired catches at the less affected inshore Station 3 (n-m isobath) were nearly identical. Similar but less persuasive evidence was obtained from paired sets facing up-bay at Port Heiden 2 days later.

This result implies that the direction of sockeye migration is not altered by strong adverse currents, insofar as large numbers of juveniles were not swept into sets facing into the flood tide. If sockeye adjusted either the depth or distance offshore of their migration path



1985 Juvenile Sockeye Purse Seine Catch by Direction of Set

Dames & Moore

Figure 43

TABLE 26

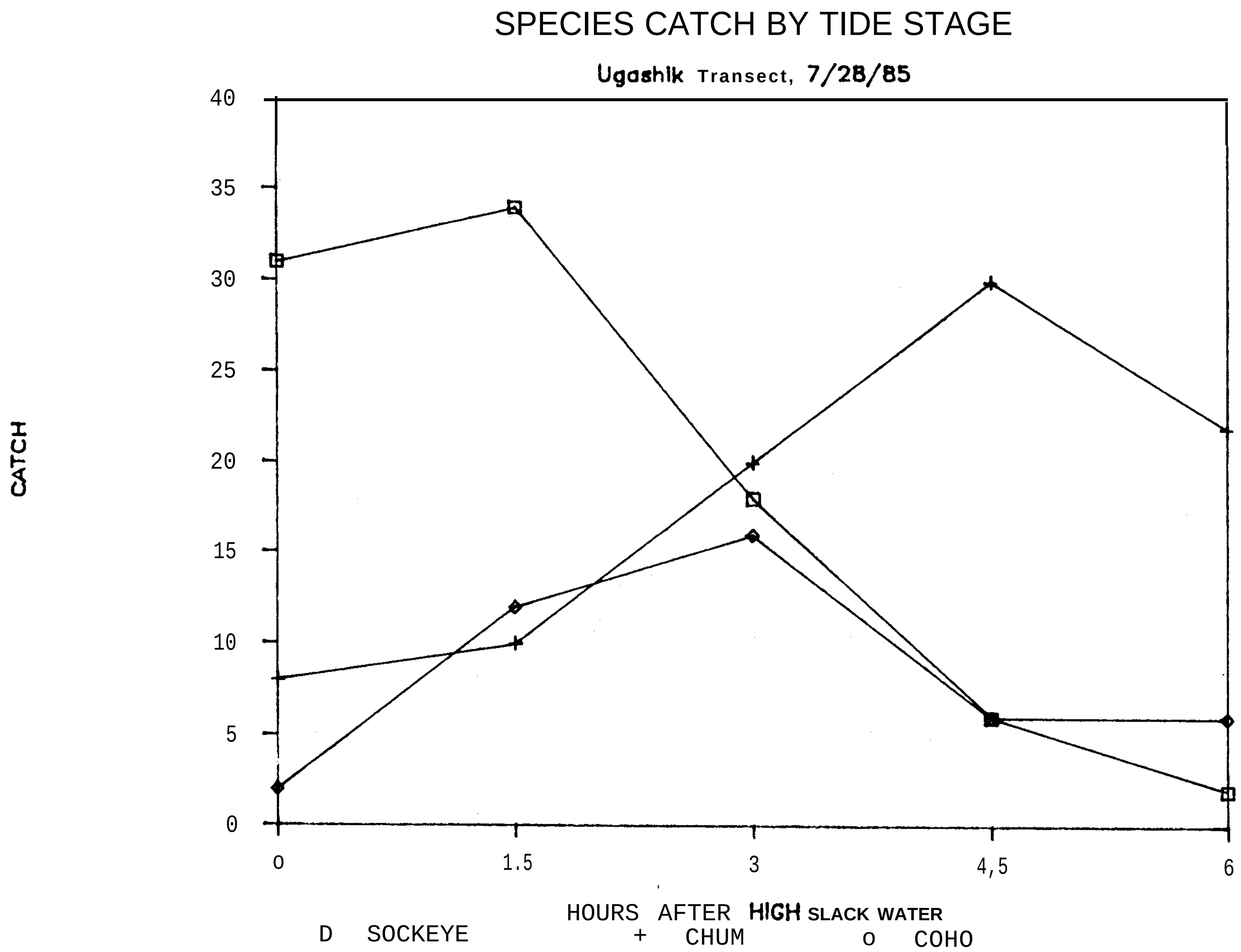
SUMMARY OF CATCHES OF JUVENILE SOCKEYE SALMON IN CRUISE 4 EXPERIMENTAL PURSE SEINE SETS

DATE	TRANSECT	STATION	DIRECTION OF SETS	SET 1 CATCH	TIDE STAGE	SET 2 CATCH	TIDE STAGE
6/26	PORT MOLLER	3	DOWN	29	EBB	5	HI SLACK
		2	DOWN	1	EBB	1	FLOOD
		1	DOWN	59	EBB	5	FLOOD
		0	DOWN	0	FLOOD	NO SET	
7/23	PORT MOLLER	3	UP	7	FLOOD	8	EBB
		2	UP	0	FLOOD	1	EBB
		1	UP	0	FLOOD	72	EBB
		0	UP	0	FLOOD	NO SET	
7/2S	PORT HEIDEN	3	UP	1	EBB	73	FLOOD
		2	UP	43	EBB	12	FLOOD
		1	UP	20	EBB	14	FLOOD
		0	UP	0	FLOOD	NO SET	
7/27	UGASHIK	2	UP	62	EBB	04	HI SLACK
		1	UP	24	EBB	17	EBB
		0	UP	2	EBB	3	EBB
7/28	UGASHIK	2	UP	31	EBB		
		2	UP	34	EBB		
		2	UP	18	EBB		
		2	UP	6	EBB		
		2	UP	2	EBB		

to avoid the mainstream of adverse currents, then their differential availability to the purse seine would be shown as differences in CPUE on alternate tide stages. Note for comparison that paired sets facing up-bay through a single ebb tide at Ugashik on July 27 showed nearly identical catch rates even though the sets were separated in time by several hours.

A final series of purse seine sets was conducted at Ugashik on July 28 to establish the repeatability of catches with location and tide stage fixed. Station 2 was sampled five times at 1.5-hour intervals beginning at high slack tide. We have no satisfactory explanation for the observed regular pattern of replacement of sockeye in the catch by juvenile chum salmon over the course of the experiment (Figure 44). The fact that sockeye were replaced by juvenile chum, which are typically associated with intertidal habitats in the study area, suggests that juveniles of both species were advected or actively moved offshore with an extremely strong ebb current characteristic of Ugashik Bay (e.g., Straty 1975; S. Parker, University of Washington, personal observation).

In view of these confounding effects in the catch data, the consistency of observed trends is remarkable. For example, catches in up-bay facing sets at the Ugashik transect were virtually identical on June 19 and June 20 in terms of numbers caught and their distribution offshore. The same pattern and nearly identical numbers were observed 2 days later at Port Heiden. The correlation between Ugashik and Port Heiden catches persisted through the survey period. Such low variability in catch rates in such a dynamic sampling environment suggests a relatively cohesive migration through the inner Bay. We submit that time/space distributions of sockeye in inner Bristol Bay are accurately described by catches at Ugashik and Port Heiden. However, the catch data for Port Moller and Izembek Lagoon transects are extrapolated only to the extent that they reflect a low fish density in the nearshore area of outer Bristol Bay.



1985 Juvenile Salmon Purse Seine Catch With Time After High Slack Water, Ugashik

Dames & Moore

Figure 44

Comparisons between the present results and those reported by Straty (1974) and Straty and Jaenicke (1980) are hampered by differences in sampling methods and survey design. As discussed in Section 4.2.7, the most obvious of these are the much larger vessel and net employed in the earlier survey, their longer duration of sets, differences in transect location and direction offshore, distribution of fishing effort in the study area, and relative abundances of sockeye smelts in years of the surveys. In addition, differences in seasonal timing between years also limit comparisons between the two survey programs to a few generalities.

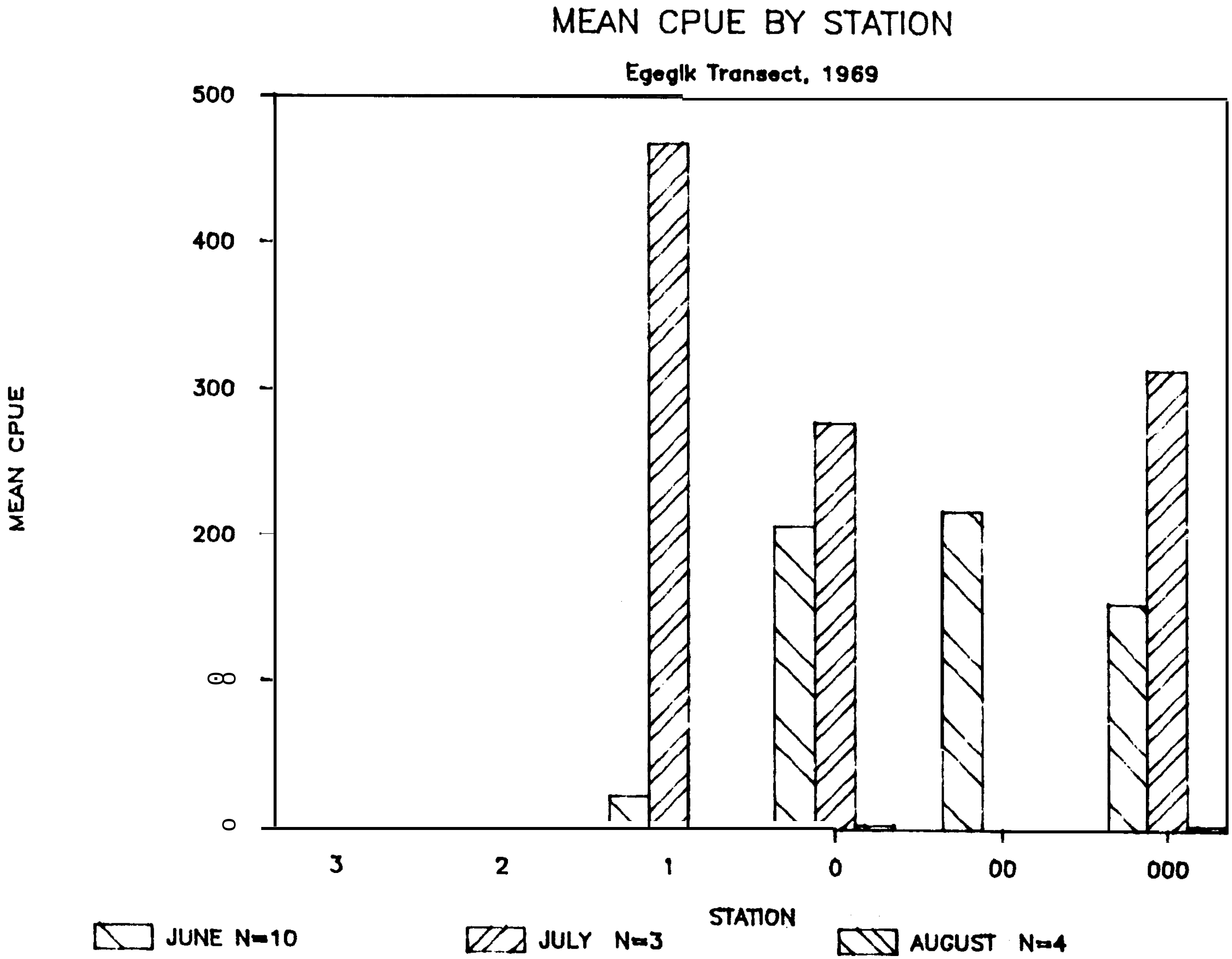
In the discussion below we do not compare CPUE directly between Straty and Jaenicke's data and the present study, but instead compare trends in the distribution of CPUE in the two studies at comparable locations and dates. We have concentrated on the data for 1969 and 1970 because they are the most comprehensive and systematic for the surveys performed between 1966 and 1971. To facilitate comparisons between station locations, those given in the raw data of Straty and Jaenicke have been stratified according to our survey design so that stations falling within the distance strata defined by our study have been numbered according to our system (Table 27).

The distribution of CPUE reveals some features of the 1969 sockeye migration that contrast with or contradict the results of the present study, while others agree in principle. Trends in mean CPUE did not show declines with distance toward the outer bay, nor were declines over time similar to those in the present study (Figures 45 through 47). Mean transect CPUE at inner bay transects was relatively lower in June than in July, whereas peak mean CPUE occurred at Port Moller in June. Catches decreased substantially at all transects in August. The fact that largest catches typically were recorded off Port Moller rather than at inner Bay transects is in stark contrast to our results and is likely a function of differences in timing between the two sampling programs.

TABLE 27

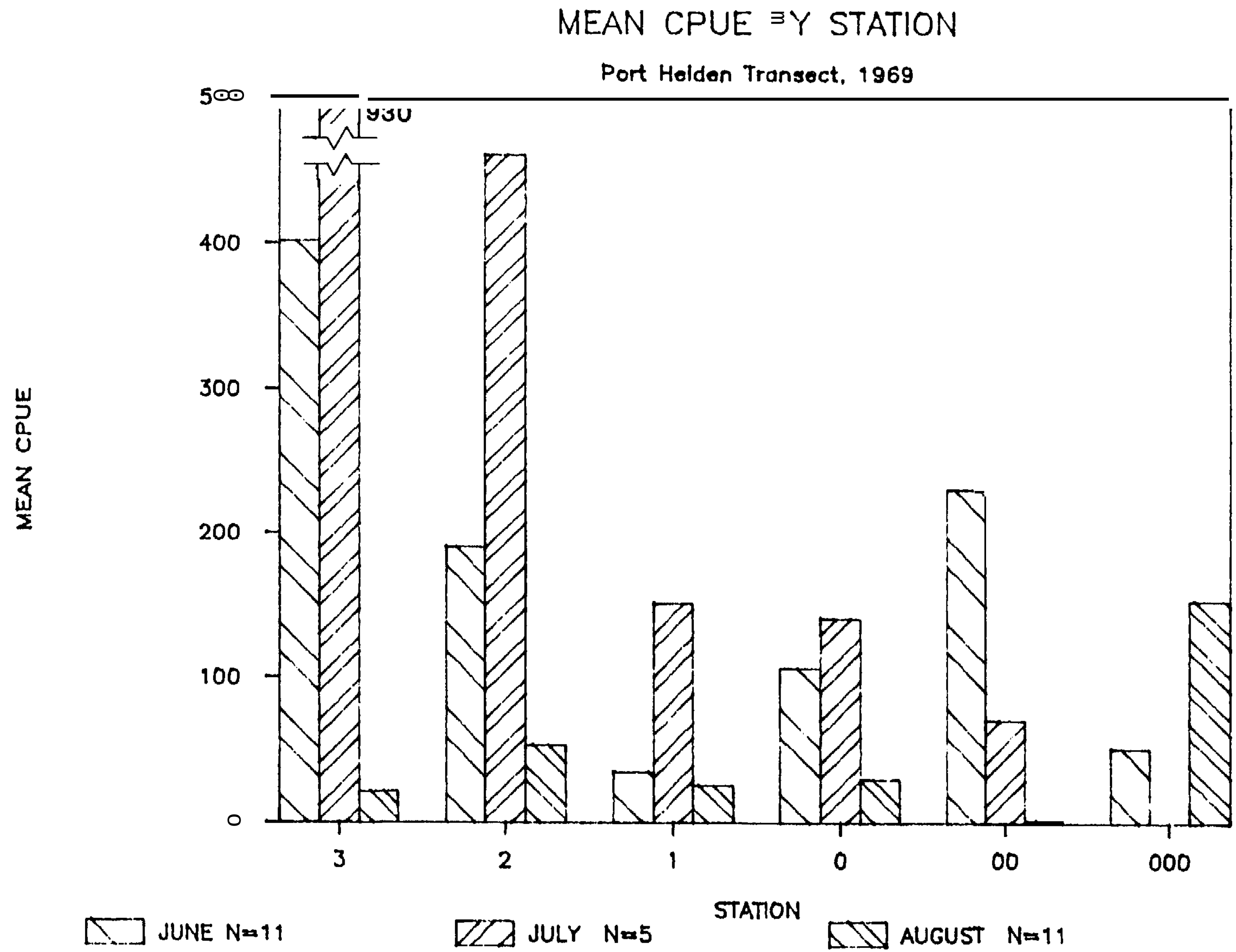
STATION DESIGNATIONS USED IN GROUPING SAMPLING SITES OCCUPIED BY STRATY AND JAENICKE

DISTANCE OFFSHORE (nautical miles)	STAT 10N DESIGNATION
O - 3.5	3
3.6 - 7.5	2
7.6 - 12.5	1
12.6 - 17.5	0
17.6 - 22.5	00
22.6 - 40.0	000



1969 Juvenile Sockeye Purse Seine Catch At Egegik
(Drawn From Data Reported by Straty 1974)

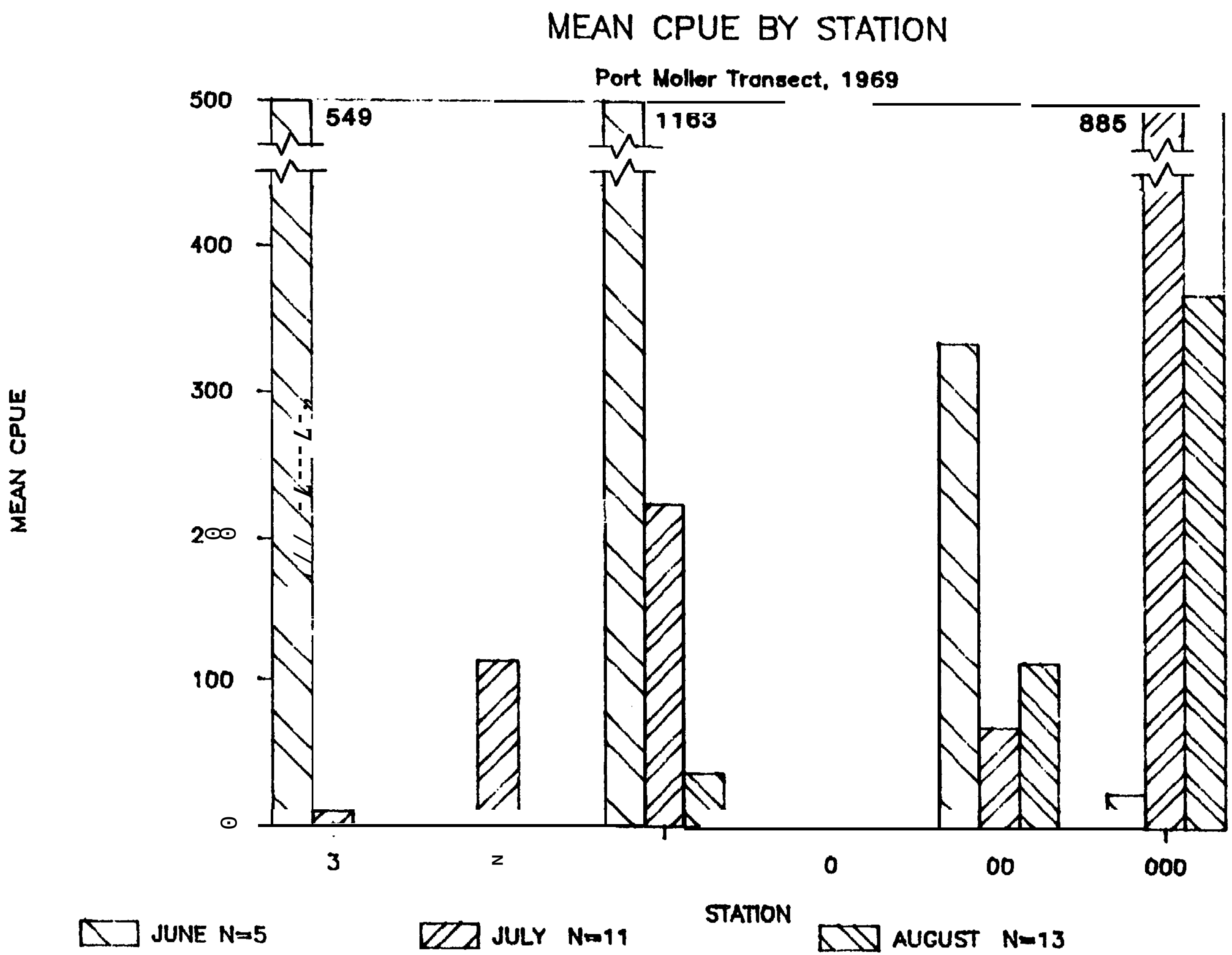
Figure 45



1969 Juvenile Sockeye Purse Seine Catch At Port Heiden
(Drawn From Data Reported By Straty 1974)

Dames & Moore

Figure 46



1969 Juvenile Sockeye Purse Seine Catch at Port Moller
(Drawn From Data Reported by Straty 1974)

Figure 47

Dames & Moore

Trends in the distribution offshore were consistent with those in the present study. Results at Egegik are not included in this discussion because of the lack of comparable data. However, the trend in CPUE at stations on the Port Heiden transect showed a strong inshore bias in June and July (Figure 46), consistent with present results. Similarly, catches at Port Moller reflected high sockeye abundances within 15 nm of shore in June and became more pronounced offshore in July and August (Figure 47), consistent with our conclusions.

Results of sampling at the Port Moller transect in 1970 are inconclusive but tend to confirm the trends described above (Figure 48). Sockeye abundance was higher in June than in August, and the center of distribution across the transect appeared to shift somewhat from nearshore in June to more offshore in August.

4.4 GENERAL DISCUSSION OF JUVENILE SALMONID DISTRIBUTIONS AND MOVEMENTS

4.4.1 1984 - 1985 Comparisons

It is misleading to compare the results of the 1984 and 1985 surveys across years in terms of calendar dates. Given the vastly different climatic circumstances involved, it is more appropriate to view Cruises 1 through 3 in 1984 as a summer-fall extension of the spring 1985 survey. Virtually all of Cruise 4 was conducted in water temperatures colder than those observed at the beginning of Cruise 1 (late June) in 1984 (Figure 49). Since the biological processes governing the initiation of spring fish migrations are at least partially temperature-dependent, it is necessary to consider climatic state when comparing distribution trends.

The 1985 survey provided data to answer the main question raised by consistently low CPUE in the 1984 survey. A hypothesis put forth in Section 4.2.7 to explain our low catch rates in 1984 suggested that low CPUE through the summer and fall months could indicate that juvenile salmonids did not extensively use nearshore habitats in the study area.

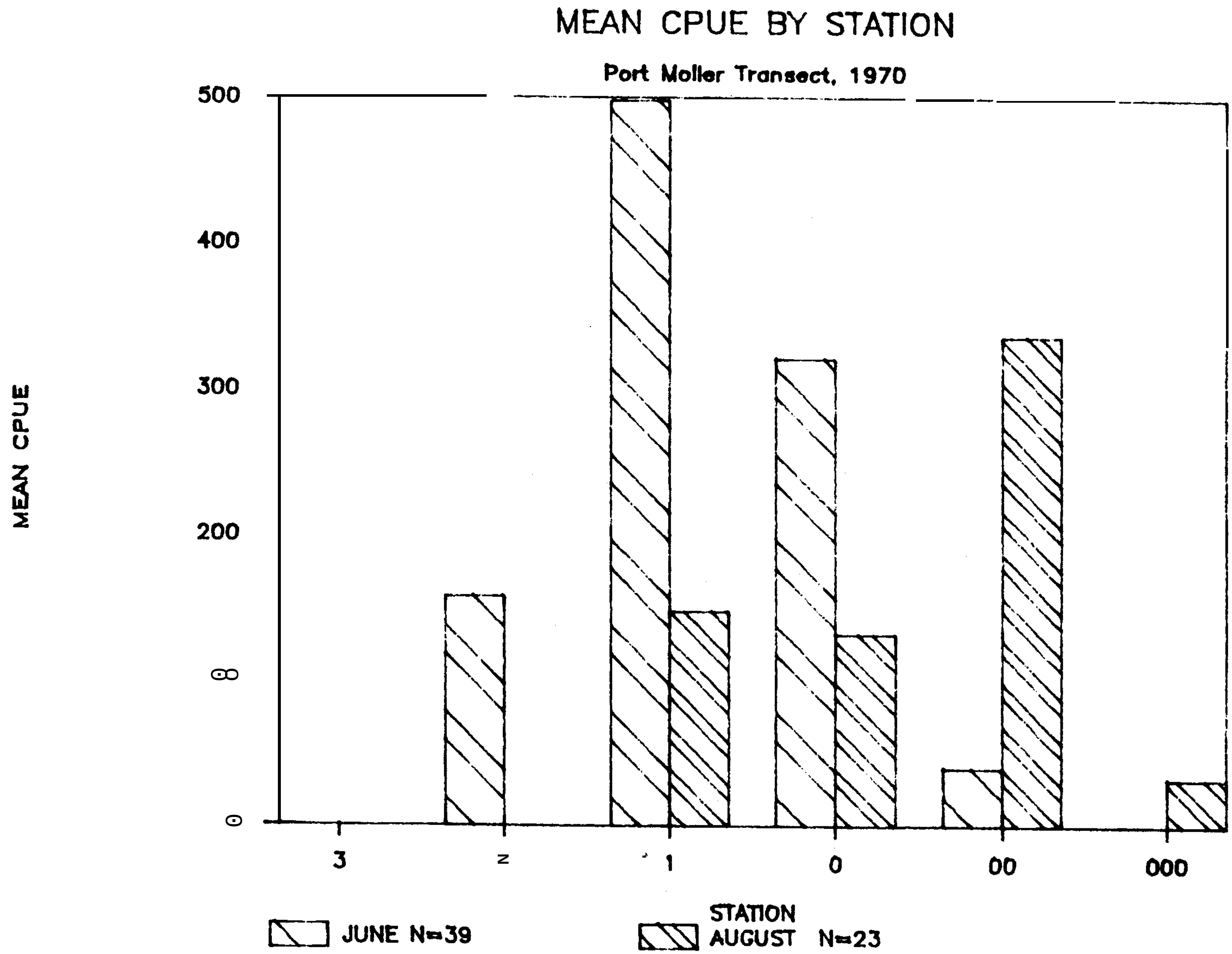
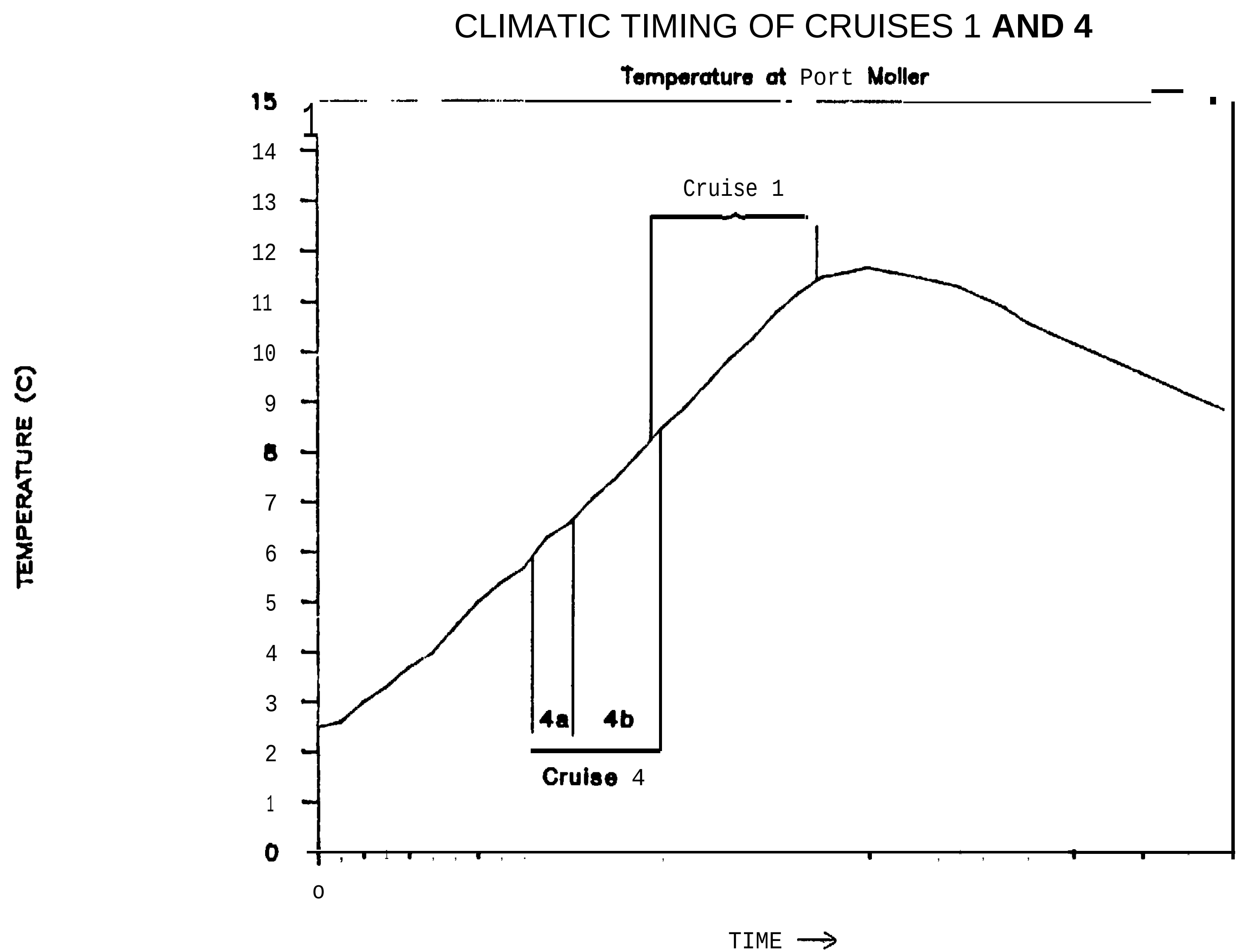


Figure 48

Dames & Moore

1970 Juvenile Sockeye Purse Seine Catch at Port Moller
(Drawn From Data Reported by Straty 1974)



Timing of Cruise 1 (1984) and Cruise 4(1 985) Relative to Port Moller Sea Surface Temperatures

Results from the 1985 survey conclusively show that juvenile salmonids of all species reside in estuarine and nearshore neritic habitats, and that some species appear to be obligate nearshore residents during early marine life history.

Our original explanation (Section 4.2.7) for unexpectedly low CPUE in 1984 purse seine sets was confirmed by catches in 1985. Based on calculated juvenile migration rates, it was concluded that purse seine sampling in 1984 had missed the peak of sockeye abundance in the study zone. Bay-wide migrations of juvenile sockeye in both 1984 and 1985 were dominated by smelts from the Ugashik and Egegik systems, which skewed the temporal patterns of peak abundance toward early migrations. Sampling began much earlier, in terms of spring climate, in 1985 relative to 1984, and peak sockeye migratory activity was shown to occur at water temperatures much lower than those at the beginning of sampling in 1984 (Figure 49).

4.4.2. Conceptual Model of Juvenile Sockeye Migration

Juvenile sockeye salmon are present in the NAS study area in variable numbers for a period of roughly 15 to 20 weeks, from late May to at least mid-September and perhaps October (Straty 1974). The spatial distribution of sockeye within this time frame is, of course, dynamic since juveniles apparently are moving in a unidirectional migration from inner Bristol Bay toward the outer bay. Consequently, discussions of particular features of the sockeye migration are complicated by the need to define abundance distributions with respect to both time and space. Such complex situations are simplified by collapsing the spatial domain to a fixed geographic reference point, which for convenience we have set to Port Heiden.

The distribution of sockeye abundance in the study area reflects the mixing of several major stocks in space and time. We assume that three variables essentially control mixing proportions and the resulting temporal distribution of sockeye abundance at the Port Heiden transect:

1. Timing of smelt outmigrations (i.e., relative earliness or lateness within river systems, and the chronological order of smolt outmigration between river systems).

2. Relative abundance of smelts produced by each of the major river systems.

3. Travel time from river system to the study area, which is a function of distance traveled and migration rate (in turn, a function of size) of juveniles.

These factors are examined in detail to determine their relative importance and the effects of annual variability in moderating the distribution of juveniles at Port Heiden.

Timing of annual smelt migrations from Bristol Bay river systems defines the initial day, or day O, of the migration into the NAS study area. Annual variation in smelt outmigration timing is documented by ADF&G smelt enumeration reports to be correlated with spring climate to the extent that cold springs delay migration. Migration timing of the individual stocks is segregated to varying degrees, but it is not clear whether climatic variability affects the chronological order and temporal segregation of smelt migrations. The degree of variation in timing of smelt migrations between years was quantified by calculating the migratory time densities (Mundy 1979) for each major river system using data for 1982-85. This set of years includes two "cold" (1982, 1985) and two "warm" (1983, 1984) springs (Figure 16). Data for Ugashik and the Nuyakuk portion of the Nushagak migrations were not collected in 1982.

Analysis of migratory timing revealed that the central date of migration within stocks varies with climatic conditions over a period of 1 to 3 weeks, but the chronological sequence and temporal segregation of stock migrations are resistant to climatic variability. Migrations are earlier in warm years than in cold years for all stocks (Table 28). Egegik smelts generally migrate first, followed by Kvichak in most years, then Ugashik, Naknek, Nuyakuk, and Wood River smelts in order.

TABLE 28

CENTRAL DATES OF SOCKEYE SMOLT MIGRATIONS FROM BRISTOL BAY RIVER SYSTEMS

YEAR	KV I CHAK	WOOD	NAKNEK	EGEGIK	UGASHIK	NUYAKUK
1982	6/2	7/9	6/14	6/5	---	---
1983	5/20	6/27	6/8	5/26	6/3	6/11
1984	5/28	6/22	6/7	5/27	5/31	6/4
1985	6/11	7/1	6/10	5/29	6/5	6/11
MEAN	6/2	6/30	6/10	5/30	6/3	6/9
SD (days)	6.6	7.2	3.1	4.5	2.5	4.0

Variability in earliest to latest central dates of migration generally is less for systems along the east side of Bristol Bay. The central date of Kvichak smelt migration spanned 14 days from May 28 in the warm years to June 11 in the cold spring of 1985 (Figure 17). This is a representative range of peak migration timing for **Kvichak** smelts. The midpoint of Wood River smelt migrations is the most variable, ranging over a 19-day period from June 22 in 1984 to July 9 in 1982 (Figure 18). This is probably typical of multi-lake systems in which the central date of migration may be influenced as much by differential timing and productivity of nursery lake substocks as by climatic factors.

Despite interannual variability in central dates of migration, variability in temporal spacing between smelt migrations is remarkably low for all stock combinations except those involving the Kvichak stock (Table 29). For example, temporal separation in central dates of the Egegik and Naknek smelt migrations for 1982-1985 was on average 11.8 days and varied by only ± 2.4 days (95 percent confidence limit) for cold and warm years combined. The Egegik migration preceded the Kvichak migration by an average of 3.3 days, but the segregation in timing of these smelt runs was not clear. In general, however, the sequence of smelt emigrations from the major river systems of Bristol Bay exhibits a rather precise linkage in order and relative timing regardless of climatic conditions.

Aside from the earliness or lateness of smelt migrations in a given year, the time of greatest sockeye abundance off Port Heiden is determined by the time and distance from the study area at which the largest concentrations of smelts enter saltwater. At the present time, smelt production from each of the major Bristol Bay river systems is routinely estimated by **ADF&G** from acoustic counters deployed during outmigration at the outlets of the nursery lakes. Although the Kvichak stock has the largest capacity for smelt production and typically provides the bulk of all smelts entering Bristol Bay, production is variable over two orders of magnitude from about 250,000 (1966) to nearly 250 million (1978).

TABLE 29

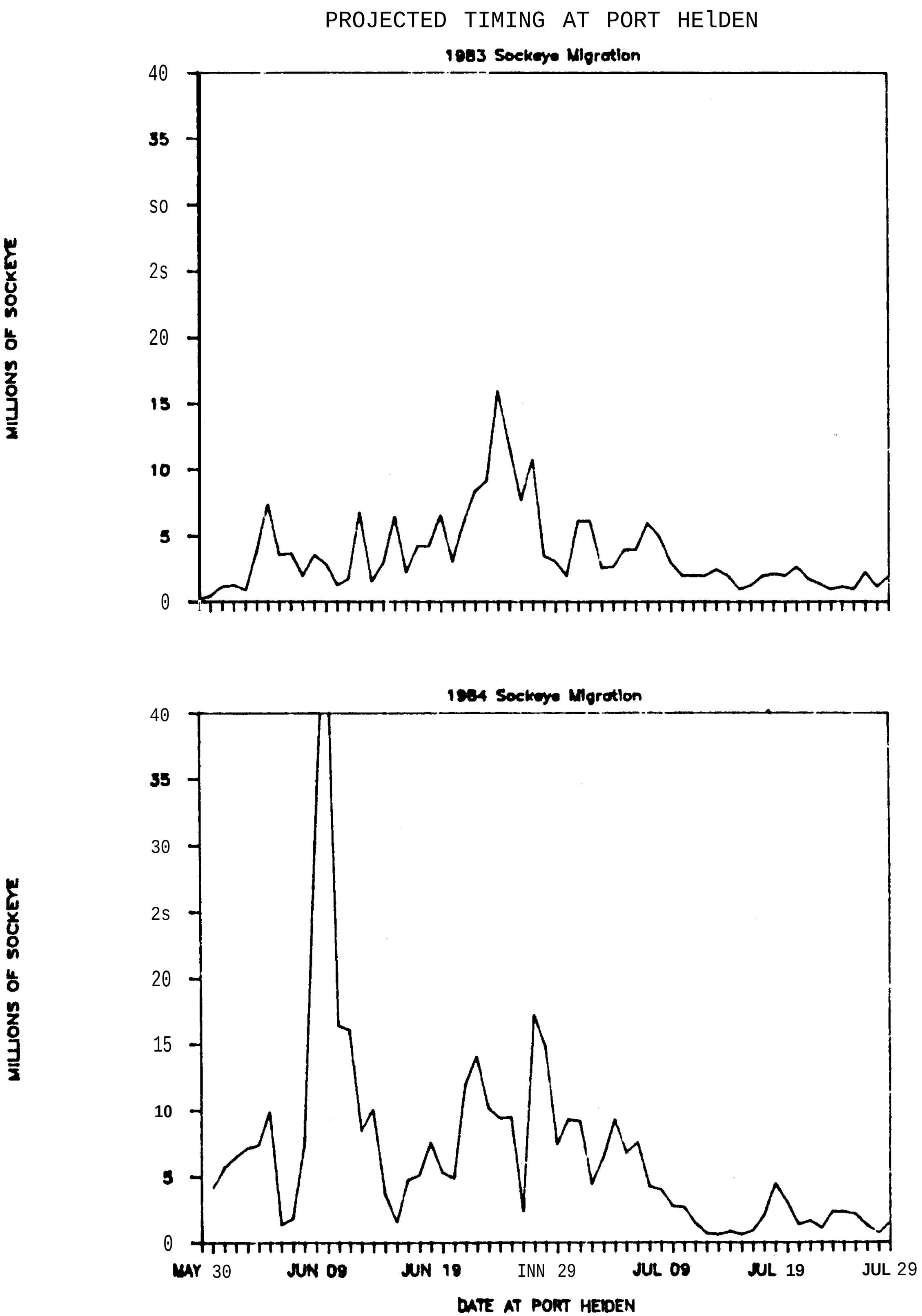
MEAN SEPARATION IN DAYS BETWEEN CENTRAL DATES OF MIGRATION FOR BRISTOL BAY SOCKEYE SMOLTS, 1982-1985 (STANDARD DEVIATIONS INDICATED IN parentheses)

	KVICHAK	WOOD	NAKNEK	EGEGIK	UGASHIK	NUYAKUK
KVICHAK	0.0	25.8 (4.3)	7.0 (5.5)	-3.3 (6.8)	1.0 (5.1)	7.0 (5.7)
WOOD		0.0	-18.8 (2.6)	-30.5 (3.1)	-24.8 (2.2)	-18.8 (2.2)
NAKNEK			0.0	-11.8 (1.0)	-6.0 (1.2)	0.5 (2.5)
EGEGIK				0.0	5.5 (2.4)	11.8 (3.5)
UGASHIK					0.0	6.0 (1.6)
NUYAKUK						0.0

In both 1984 and 1985 the contributions of smelts from the Egegik and Ugashik systems predominated in the bay-wide smelt migration. The Kvichak system produced the majority of smelts in 1983. It is apparent from Table 29 that the Kvichak, Egegik, and Ugashik migrations are separated in time by only a few days, but they are separated in space by over 200 km. The effect of this distance in modifying the temporal pattern of abundance off Port Heiden is demonstrated in Figure 50, wherein Bristol Bay smelt migrations in 1983 and 198’4 have been projected to their time of arrival at Port Heiden based on a fixed migration rate of 10 km/day. The early peak in 1984 represents the passage of Egegik and Ugashik sockeye, while the late peak in 1983 marks the passage of Kvichak fish. Dates of peak juvenile sockeye abundance off Port Heiden in these projections varied by about 2 weeks.

Under fixed conditions of time and location of departure, the arrival of Bristol Bay stocks of sockeye off Port Heiden is influenced also by the migration rate of juveniles. Figure 51 illustrates the difference in temporal distributions of juvenile sockeye off Port Heiden in 1982 predicted by varying migration rate from 10 km/day for all stocks to 1 b.l./sec. for individual stocks. Peak abundance of the Kvichak stock is displaced about 3 weeks later if 1 b.l./sec.is used to calculate migration rate. Timing of the Egegik and Naknek stocks at Port Heiden would not change much in the simulations because 10 km/day is roughly equivalent to a migration rate of 1 b.l./sec.for a 115 mm juvenile, which is near the mean length of smelts leaving these rivers in 1982.

Average smolt lengths tend to be strongly stock-specific and may differ by up to 30 mm between stocks, but variation in mean smelt length within a stock probably seldom exceeds 10 mm (Figure 24). Size differences of a few millimeters would have relatively little effect on travel time to Port Heiden if swimming speed is a constant function of body length (Table 30). However, minor differences in swimming speeds could cause significant changes in migration rate and travel times. Note that a 90-mm smelt swimming at 1.5 b.l./sec. is the equivalent of a 135-MM smelt swimming at 1 b.l./sec. Since sockeye smelts can travel at

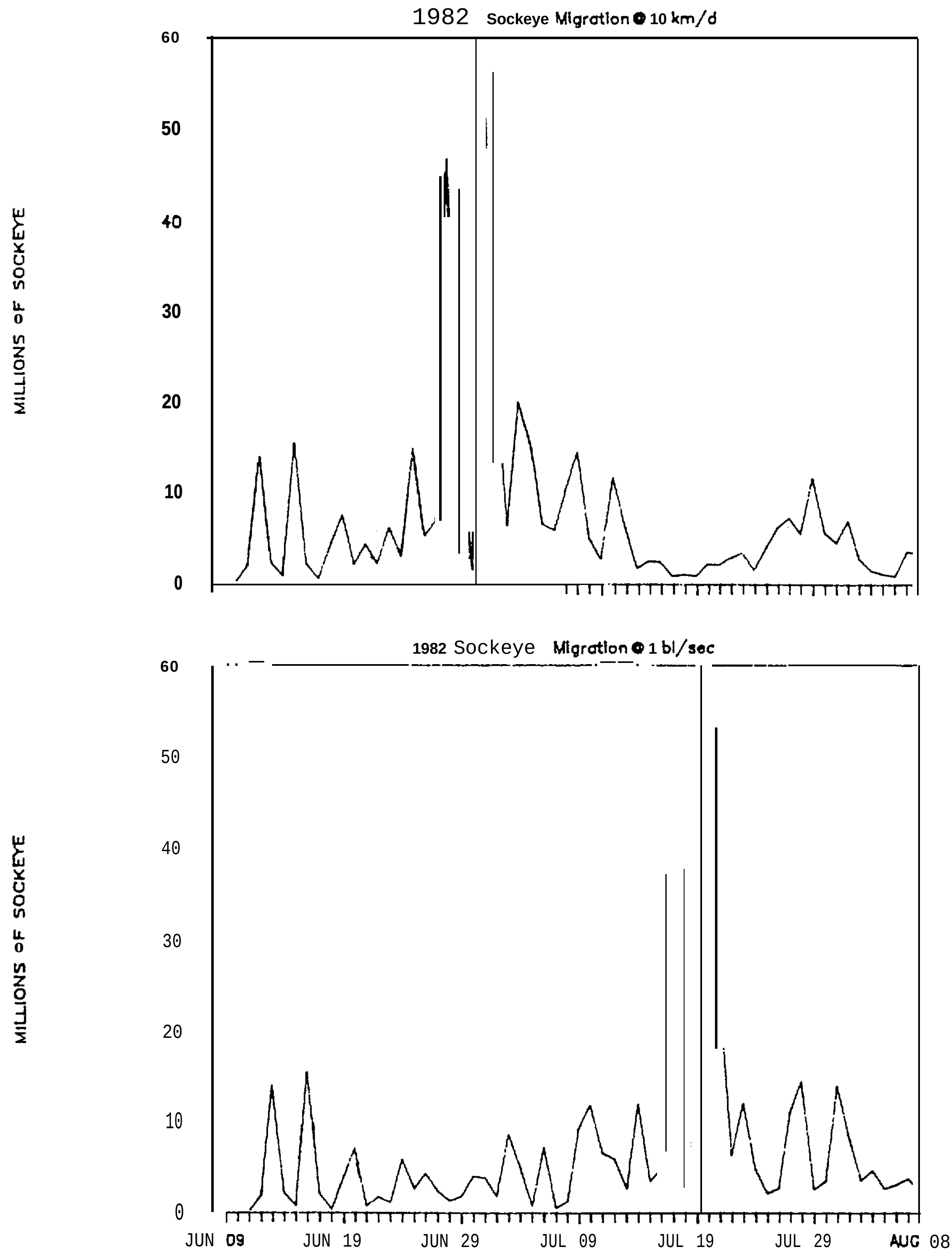


Predicted Timing of Juvenile Sockeye Migration at Port Heiden in 1983 (Top) and 1984 (Bottom) Based on Migration Rate of 10 km Per Day

Dames & Moore

Figure 50

PROJECTED TIMING AT PORT HElDEN



Predicted Timing of 1982 Juvenile Sockeye Migration at Port Heiden Based on Migration Rates of 10 km Per Day (Top) and One Body Length Per Second (Bottom)

Dames & Moore

Figure 51

TABLE 30

CALCULATED TRAVEL TIMES OF JUVENILE SOCKEYE
TO PORT HEIDEN FROM RIVERS OF ORIGIN
BASED ON A SWIMMING SPEED OF ONE BODY LENGTH PER SECOND

LENGTH (CM)	MIGRATION RATE (KM/D)	TRAVEL TIME TO PORT HEIDEN (DAYS)				
		KVICHAK	WOOD	NAKNEK	EGEGIK	UGASHIK
6.5	5.6	50	52	45	27	16
7.0	6.0	54	48	42	25	15
7.5	6.5	50	45	38	23	14
0.0	6.9	47	42	36	22	13
8.5	7.3	45	40	34	21	12
9.0	7.8	42	37	32	19	12
9.5	0.2	40	35	30	18	11
10.0	8.6	38	34	29	17	10
10.5	9.1	36	32	27	16	10
11.0	9*5	34	31	26	16	9
11.5	9*9	33	29	25	15	9
12.0	10.4	31	28	24	14	9
12.5	10.8	30	27	23	14	8
13.0	11.2	29	26	22	13	8
13.s	11.7	28	25	21	13	8
14.0	12.1	27	24	21	12	7
14.5	12.s	26	23	20	12	7
15.0	13.0	25	22	19	11	7
15.5	13.4	24	22	19	11	7
16.0	13.8	24	21	18	10	7
16.5	14.3	23	20	17	10	6
17.0	14.7	22	20	17	10	6
17.5	15.1	22	19	17	10	6
1s.0	15.6	21	19	16	9	6
18.5	16.0	21	18	16	9	6
19.0	16.4	20	18	15	9	6
19*5	16.9	20	17	15	9	5
20.0	17.3	19	17	14	9	5
50.0	43.0	8	7	6	3	2

sustained rates of 1 to 2 b.l. /sec. (Hoar and Randall 1978), it is easily conceivable that variability in swimming speeds could differentially influence migration rates of Bristol Bay stocks.

Migration swimming speeds have not been measured directly for Bristol Bay juvenile sockeye, but available evidence suggests that 1 b.l./sec. is a likely value. Smelt marking experiments reported by Straty (1974) have been summarized in Figure 19 and Table 31. Means of migration rate estimates calculated for pooled stocks by year and for pooled years by stock converge to a grand mean of 9.6 km/day, which is very close to 1 b.l./sec. for a juvenile of average Bristol Bay size. Since swimming speed can be influenced by water temperature (Brett, et al. 1958), migration rates may be lower in cold years than in warm' years.

Other sources also support an average migration rate of 1 b.l./sec. for juvenile sockeye. Bax (1985) showed by regression analysis of migration rate on fish length that Straty's (1974) mark/recapture data are best fit by a line representing a mean swimming speed of 0.9 b.l./sec. The precision of the relationship was such that there is no statistical distinction between 0.9 and 1 b.l./sec. Estimates calculated from data given in Hartt (1980) for tagged juvenile Fraser River and Skeena sockeye indicate a range in observed swimming speeds of 0.7 to 1.7 b.l./sec. and 0.7 to 1.9 b.l./sec., respectively. It is noteworthy that these estimates obtain even though Fraser and Skeena sockeye migrate north with a favorable current (Hartt 1980) whereas Bristol Bay sockeye migrate southwest against an adverse net current.

To summarize thus far, analysis of factors presumed to affect the timing of juvenile sockeye movements in the eastern Bering Sea suggests that initiation of smelt migration is variable within a stock over a 1- to 3-week period, depending on spring temperatures. Alaska Peninsula stocks tend to migrate earliest and show least variation in central date of migration, while Wood River sockeye migrate latest and show greatest variation in timing. The order and temporal segregation of stock migrations are largely independent of climatic variability. While first presence of juveniles at Port Heiden is largely a function of the timing of

TABLE 31

SUMMARY OF MEAN MIGRATION RATE ESTIMATES (KM/DAY) FOR
SOCKEYE SALMON SMOLTS MARKED BY STRATY AND JAENICKE IN STUDIES, 1967-70

YEAR		WOOD	KVICHAK	NAKNEK	UGASHIK	ALL STOCKS
1967	MEAN		9.8		3.8	5.3
	ST. DEV.		0.0		1.1	3.1
	RECOVERIES	N/A	1.0	N/A	3*O	4.0
1969	MEAN	6.5		4.6		6.4
	ST. DEV.	1.8		1.1		2.7
	RECOVERIES	28.0	N/A	9.0	N/A	37.0
1970	MEAN	3.9			6.2	5.0
	ST. DEV.	0.4			5.1	3.7
	RECOVERIES	6.0	N/A	N/A	6.0	12.0
					ALL STOCKS	6.0
YEARS POOLED	MEAN	6.1	9.8	4.6	5.4	5.8
	ST. DEV.	2.0	0.0	1.1	4.3	
	RECOVERIES	34.0	1.0	9.0	9.0	

Egegik and Ugashik smelt migrations because they are the earliest and closest systems, the center of the temporal distribution of sockeye abundance is determined by the timing of the system providing the largest number of smelts to the bay-wide migration in any year. Peak abundance at Port Heiden will occur within 1 to 2 weeks of the Egegik or Ugashik migrations if these systems produce the majority of smelts, whereas peak abundance could be as late as mid-August if Wood River produces the majority. Migration rates probably vary little within stocks but considerably between stocks if swimming speed is assumed to be approximately constant and proportional to body length. However, relatively small differences in swimming speed could profoundly alter the timing of stocks off Port Heiden. Available evidence uniformly suggests that 1 b.l./sec. is a most likely swimming speed for Bristol Bay juvenile sockeye in the nearshore areas of the eastern Bering Sea.

4.4.3 Offshore Distribution

One of the more intriguing unanswered questions about the distribution of juvenile sockeye concerns the pattern of offshore dispersion at various times and locations in the study area. While the results of this study, combined with those reported variously by Straty (1974, 1975, 1981), form a reasonably coherent description of the juvenile sockeye migration, information supporting a predictive model of migration patterns within the nearshore zone is almost totally lacking. The following section reviews empirical data on, and proposed explanations for, sockeye distributions in the study area.

The first problem in assessing distributional trends is to identify whether changes in CPUE relate to changes in absolute abundance or in distribution. The time series of sockeye purse seine CPUE at Ugashik in 1985 (Figure 28) shows diminishing sockeye densities over time that could have resulted either from declining absolute abundance in a fixed migration band, or from fixed abundance dispersing offshore with time. The pattern of estimated total daily juvenile sockeye abundance at Ugashik (Figure 30) indicates that reduced abundance probably accounts for decreasing CPUE in this case.

However, the pattern of diminishing CPUE with distance down-bay must have resulted from a changed offshore distribution, rather than lower abundance. Reduced catches at the Port Moller and Izembek Lagoon transects could indicate either that sockeye indexed at inner bay transects had dispersed uniformly in lower density across and outside the sampling area, or that the center of density of the migration had moved beyond the offshore extent of sampling in 1985. The latter argument is supported by the results of Straty (1974).

The generalized migration corridor depicted by Straty (1974) and more or less confirmed in the present study suggests that the migration of juvenile sockeye is essentially coastal within inner Bristol Bay and becomes more offshore with distance down-bay. Evidence from both studies describes a migration path compressed to within 10 nm of shore as far west as Port Heiden. Data from Straty's (1974) study indicates that the center of the migration thereafter is found 20 to 40 nm offshore.

None of the studies on juvenile salmonid migrations in the eastern Bering Sea has adequately considered an explanation for observed patterns of offshore distribution. Discussion of factors controlling the inshore\offshore distribution of sockeye necessarily is more qualitative than that relating to timing because mechanisms of dispersal have yet to be positively identified and measured. Although an innate navigational sense undoubtedly provides the major directional component to salmonid migrations, second-order interactions with the biological and physical environment likely alter migration patterns in time and space. Defining the roles and consequences of biotic and abiotic variables in modifying salmon migrations probably is the most critical remaining information need in this study.

Some studies of juvenile salmon migrations suggest that biological interactions with prey or predators drive dispersal behavior. Simenstad and Wissmar (University of Washington, personal communication) have hypothesized that the migration of juvenile chum salmon through Hood Canal, Washington reflects the movement of chum through a succession of foraging habitats. Their model suggests that growing chum move seaward in pursuit of larger prey species and higher prey densities found in neritic and offshore marine habitats. A similar mechanism has been proposed for juvenile pink salmon movements off Kamchatka (Andrievskaya 1970).

Straty (1974) and Straty and Jaenicke (1980) suggested that prey distributions may have been responsible for luring juvenile sockeye offshore near Port Moller. Straty (1974) indicated that sockeye did not feed within the inner Bay where the migration band tended to compress into coastal waters. Aggressive feeding on zooplankton was found to commence in the outer bay, where measurably higher densities of prey in offshore waters (Straty and Jaenicke 1980) could account for the offshore movement of sockeye.

Other studies suggest that the physical environment may affect migration rates and routes. Bax (1982) demonstrated a correlation between the migration rate of juvenile chum through Hood Canal and changes in residual surface outflow caused by changes in prevailing wind patterns. He concluded that juvenile chum migrations were less related to biological (prey) dynamics than to physical (circulation) dynamics.

Groot (in preparation) showed that the migration routes of juvenile salmonids from the Fraser River are strongly affected by tidal stage at entry into the Strait of Georgia. The general migration pattern is northward toward Johnstone Strait, but juveniles entering seawater on flood tides migrate in a narrow band along the eastern (mainland B.C.) shore, whereas those entering on ebbing tides are displaced as far west as Vancouver Island before beginning a northward traverse of Georgia Strait back to the mainland side.

Straty and Jaenicke (1980) cited evidence from their studies indicating that the distribution of juvenile sockeye in the eastern Bering Sea may have been correlated with water temperature to the extent that extremely cold water compressed the migration into a relatively narrow band along shore. Results from the present study shed little additional light, except to note that the proximity of very cold water near shore in 1985 coincided with a restricted offshore distribution of sockeye early in the survey. Whether or not warming of coastal waters permits a wider offshore dispersal of later sockeye migrants was not demonstrated because of the incomplete temporal coverage in each year of this study.

It is clear that numerous potential explanations for salmonid migration patterns may be applicable to Bristol Bay and the eastern Bering Sea. At the present time, however, an information base of sufficient scope and resolution to permit hypothesis testing does not exist for the region. Simple biological explanations are confounded by the tremendously complex and dynamic physical environment. Hypotheses about the influence of physical factors on migration patterns simply cannot be evaluated because relevant physical processes have not been studied at necessary levels of resolution. It is our conclusion that a complete understanding of migration dynamics awaits a fuller description of the nearshore marine ecosystem and the place of juvenile salmonids in it.

4.5 NONSALMONIDS - 1984

4.5.1 General Distribution

Of the 47 identified nonsalmonid fish species captured in 1984, 13 are generally considered pelagic and 30 are considered demersal. The remaining four species (Pacific cod, Pacific sandfish, walleye pollock and whitespotted greenling) all are often labeled as demersal. However, these species were also caught well off the bottom in the purse seine (Table la) either in juvenile stages (which are truly pelagic) or, in the case of Pacific sandfish, as larger individuals. Other species such as Pacific sand lance are found in both pelagic and demersal habitats at various times in their life history. The bulk of purse seining and tow netting was done in relatively shallow water (10 to 11 m and less for the tow net). In some cases, the seine and the tow net actually contacted the bottom. Therefore, truly demersal species may appear in these gear types that target on pelagic species.

It is noteworthy that two species reported in abundance in the nearshore areas of Bristol Bay (longhead dab, and capelin; Section 2.2.2) were not prominent in our catches, while Pacific cod, sand lance, and walleye pollock were more dominant in our catches than would be suggested by previous work, perhaps due to our smaller mesh sizes.

4.5.2 Pelagic Fish Species - 1984

"Pelagic" fish species dominated the 1984 catches. Of the five most abundant fish species in our catches (Table la) only Pacific sand lance and rainbow smelt are primarily thought of as pelagic. However, over 62 percent of the total numbers of fish caught were Pacific sand lance. In addition, juveniles of two demersal fish (Pacific cod and whitespotted greenling) were among these top five species, and were more abundant in the pelagic habitat than were larger members of these species in the demersal habitat.

Other, primarily pelagic species captured in significant numbers included Pacific herring (third in tow net catches) and surf smelt (third in beach seine catches) as well as juvenile and adult salmonids. Walleye pollock and Pacific sandfish, both primarily demersal species, ranked fourth and fifth overall in purse seine catches.

The general distribution and observed size patterns of dominant pelagic species are described below.

Pacific sand lance

The Pacific sand lance, Ammodytes hexapterus, was by far the most numerically dominant species in this study, comprising 62.5 percent of all fish captured in 1984. Sand lance was the most abundant species in both the beach seine and tow net catches. It also ranked second to Pacific cod in purse seines and fourth in otter trawl. This catch distribution illustrates the wide variety of habitats both pelagic and benthic, inshore and offshore used by this species at various times. These results seem to confirm this species' role as one of, if not the, most important forage fish in this part of the Bering Sea.

Sand lance were widely but irregularly distributed throughout the study area. As with other species, major concentrations in a few catches largely drove the apparent distribution pattern (Figures 9, 12 and 13). Beach seine catches of sand lance were greater on protected beaches, with mean catches as high as 2,360 fish in 13 sets (all cruises combined) inside Port Moller. This high catch rate was largely the result of a single haul total of over 28,000 individuals at Station 8 (Shingle Point, Herendeen Bay) in Port Moller on Cruise 1. Catches in excess of 1,000 in a haul were also recorded at Station 6 inside Harbor Point in Port Moller and on the exposed beach of Transect 3, all during Cruise 1. During Cruise 1 (late June to mid-July), in all 6 of the 10 beach seine hauls that captured sand lance, the smallest catch was 521. All sand lance were taken on Transects 3 and 4 in this cruise. Overall average catch per set was 5,107 fish in protected beach stations and 493 fish per set on exposed beaches.

In subsequent sampling periods there was a sharp, progressive decline in catches. The average on protected beaches dropped from 5,107 to 20.5 and 4.1 per set in Cruises 2 (late July to mid-August) and 3 (late August to mid-September), respectively, while the average on exposed beaches dropped from 492 to 25.3 to O in the three cruises (Figure 12).

Sand lance strongly dominated tow net catches during the first cruise at outside stations (about 900 per haul, n=8; Figure 13), but, surprisingly; were not taken in tow nets inside protected waters (only Port Moller sampled; n = 4). In Cruise 2, tow net catches of sand lance in protected waters (over 1,000 per haul; n = 10) exceeded those in outside waters (about 800 per haul), indicating a shift away from the beaches and into midbay area by mid-summer. By late summer (Cruise 3) average tow net catches at both inside and outside stations fell to less than 5 per set, suggesting, along with beach seine results, a strong offshore movement. This movement may have been confirmed by purse seine catch (outside stations only) which jumped from less than about 4 per set in Cruises 1 and 2 to over 30 per set in Cruise 3 (Figure 9). Otter trawl catches at outer stations also tended to increase slightly from Cruise 1 through Cruise 3. However, significant catches of sand lance in the otter trawls (greater than 10 in a trawl) occurred only on Transect 6, Cruise 3 (replicate hauls at Station 8 inside the north entrance to Izembek Lagoon captured 672 and 232 sand lance). Thus, not all sand lance had left Izembek by Cruise 3. This transect was, however, the first sampled on Cruise 3 and the offshore movement suspected at other transects may not have occurred yet in the southern part of the study area.

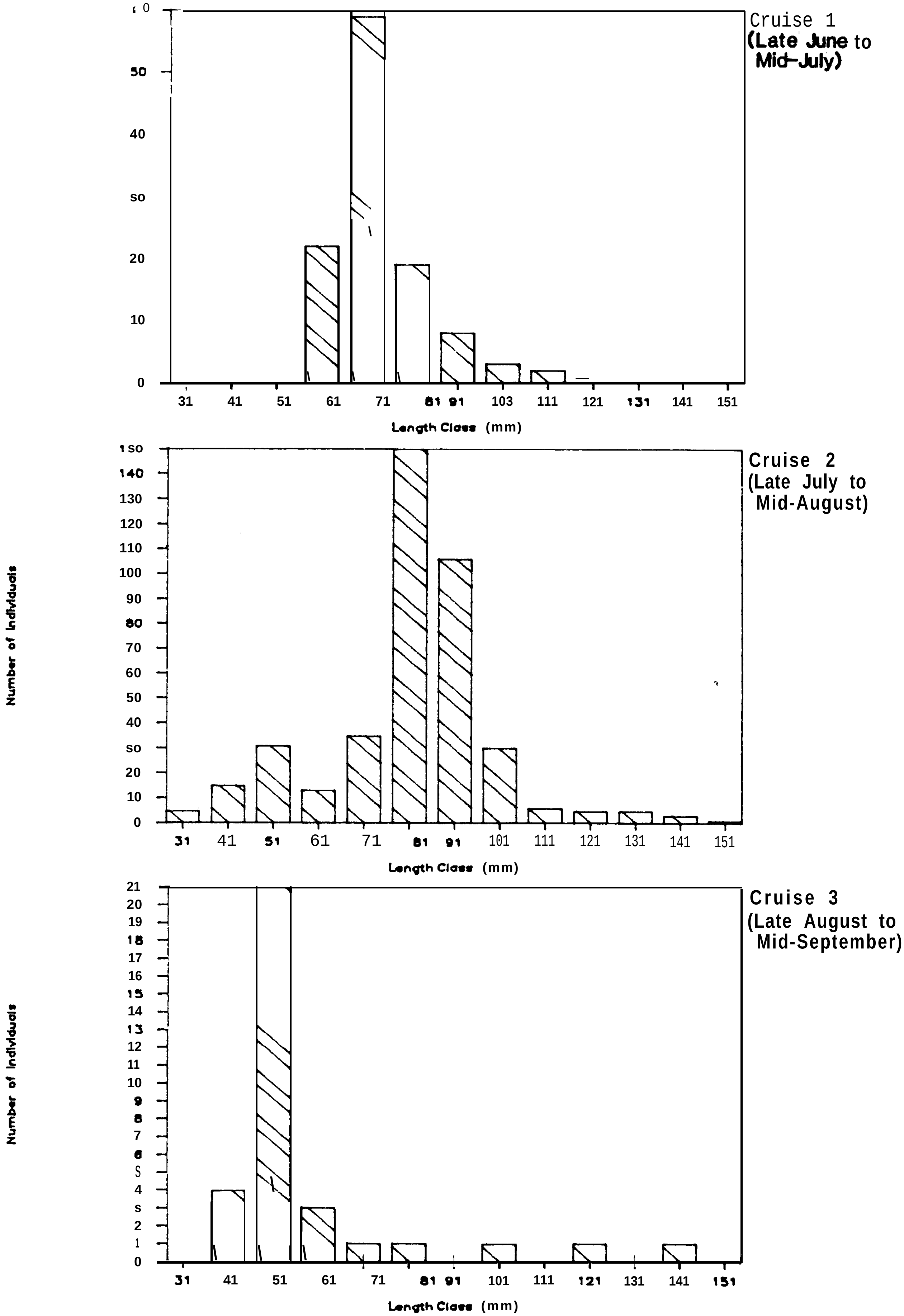
Three distinct size classes of sand lance were evident in our catches. In Cruise 1, the mode in beach seines was 71 to 80 mm (Figure 52) while a large size class (121 to 130 mm) dominated purse seine catches offshore. These two size groups were evident in the respective gears in Cruise 2, but a new group (41 to 60 mm) appeared in the beach seines. This group (now 51 to 70 mm) dominated in beach seines and otter trawls during Cruise 3. It was also strongly represented in purse seine catches which, unlike the other gear types, included all three size groups in Cruise 3. Overall, the beach seine was more effective on smaller fish than the purse seine, through which we observed small fish passing.

Rainbow smelt

The second most abundant pelagic species in our 1984 catches was the rainbow smelt (Osmerus mordax) which comprised 9.4 percent of the total catch (ranked second in both the beach seines and tow nets). Beach seine catches were greater on exposed than on protected beaches (Figure 13) during the first (late June to mid-July) and third (late August to mid-September) cruises. This relationship would likely have held in the second cruise (late July to mid-August) as well except for good catches in Ugashik Bay (Transect O) which was not sampled on other cruises. There was a steady increase in catch of rainbow smelt over the sample period (all transects combined) at exposed stations (from 5.5 to 30.5 to 83.6 per set for Cruises 1, 2, and 3, respectively). The maximum catch in any set (284 fish) occurred in Cruise 3 on the exposed side (Station 5) of Harbor Point in Port Moller.

There was a clear trend for decreasing rainbow smelt catches in beach seines from inner to outer Bristol Bay at exposed stations (Figure 13). This trend would hold for sampling in embayments as well except for significant catches inside Izembek Lagoon on Cruise 2.

Tow net catches of rainbow smelt were generally insignificant except for two replicate hauls inside Ugashik Bay on Cruise 2 which



Length-Frequency of Pacific Sand Lance in Beach Seine s,1984
(all transects and stations combined)

Dames & Moore

Figure 62

netted an estimated 2,800 and 4,200 fish. Rainbow smelt were generally poorly represented in the purse seine catches as well, with most of the catch during the third cruise on Transect 2 and 4 (Figure 9). All purse seine caught rainbow smelt were taken at the shallowest station seined (Station 3; 11 m) perhaps indicating a nearshore orientation of this species.

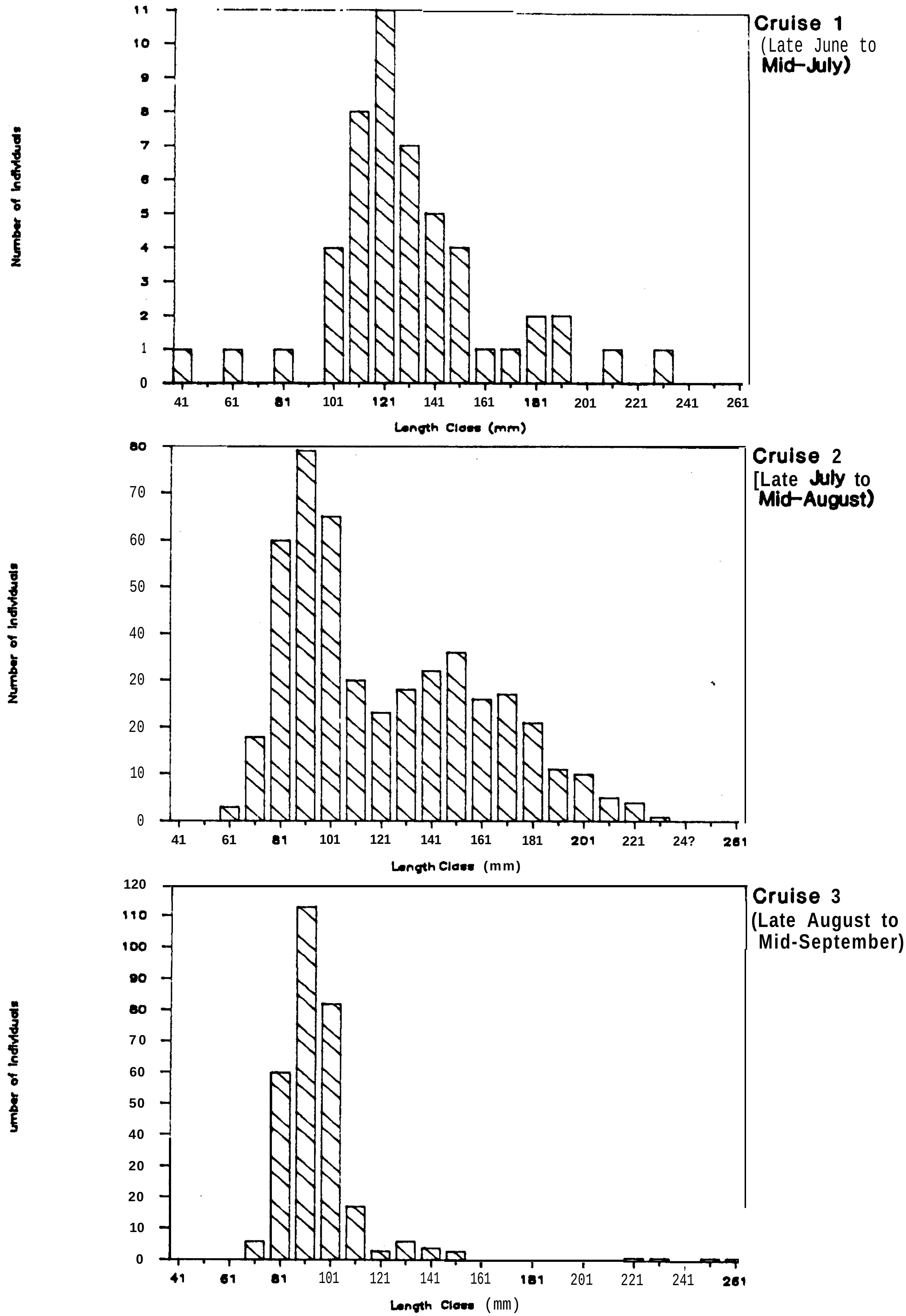
Rainbow smelt were widely distributed in otter trawls, occurring in 32 percent of all trawls. Catches never exceeded 35 per trawl, with maximum catches in Cruise 3 at the nearshore stations (6-m depth; station 4) on Transect 1 and 3. These catches emphasized a pattern of increasing rainbow smelt catch at outside (primarily shallow) stations with time and decreasing catch rates from inner to outer Bristol Bay.

During Cruise 1 beach seine (Figure 53) and otter trawls, the dominant size class of rainbow smelt was in the 111 to 130 mm range. Cruise 2 beach seines displayed a bimodal distribution of fish with peaks at 91 to 100 and 151 to 160 mm. This latter mode may represent growth of the dominant mode from Cruise 1. In Cruise 3, older fish had moved offshore leaving only a strong mode in the 80 to 109 size range in the beach seines. Offshore, purse seines took only fish greater than 130 mm during Cruise 3.

Pacific herring

Pacific herring (<u>Clupea</u> <u>harengus pallasi</u>) were taken only occasionally in tow nets and purse seines during 1984, yet they were the third most abundant species overall in tow net catches. This low catch rate is somewhat surprising considering the known spawning of herring in Port Moller in May and June and their presumed summer and fall migration route through the study area from major spawning areas on the north side of Bristol Bay (Thorsteinson and Thorsteinson 1984).

In our 71 purse seine sets only four herring were caught: two in Cruise 2 and one each in Cruise 1 and 3. In the tow nets, herring were only captured in Cruise 1 (one fish at Station 11, inner Port Moller) and Cruise 3 (736 fish at stations 4 and 7 in the entrance to, and



Length-Frequency of Rainbow Smelt in Beach Seines, 1984
(all transects and stations combined)

Dames & Moore

Figure 53

inside of Port Moller). Of these fish, more (72 percent) were taken at the inner bay stations. These fish were all young-of-the-year (37 to 55 mm) probably from the earlier spawning in Port Moller. Possibly these fish spawned in the Port in the spring and remained inside, recruiting to our gear by early fall (September). The June 26 start date was too late to capture adult herring.

Surf smelt

Surf smelt (*Hypomesus pretiosus*) was the third most abundant species taken in 1984 beach seines. Surf smelt were captured in beach seines only in Cruises 2 and 3 with the vast majority (98 percent) in Cruise 3 (late August to mid-September). Also they were captured only on Transects 4 (Port Moller) and 6 (Izembek) with the majority (about 90 percent) on Transect 6. The greatest single catch (121 fish) was on the exposed side of a sand bar in the north entrance to Izembek Lagoon. This catch included two distinct size classes, with peaks at 40 to 60 mm and 160 to 200 nun.

4.5.3 Demersal Fish Species - 1984

On the basis of numbers, fewer fish were taken in demersal than in pelagic habitats (assuming the sand lance catch in beach seines to be pelagic). However, in total weight caught, species like yellow-fin sole and rock sole included large individuals that in many cases equaled the remainder of otter trawl catches (in weight). Otter trawl catches generally exceeded the weight of most tow net and purse seine hauls. Considering the small size of the otter trawl used, one could speculate that even larger individuals or greater numbers of large individuals of these species were present and avoided the small net opening.

Therefore, to initially examine overall demersal fish distribution from otter trawls, we chose to look at mean weights of catches with all species combined. Catch distribution was examined by cruise (time) and by area (inner, middle and outer bay; inside [protected] bay versus outside [exposed] stations). Mean-weight-per-trawl data are summarized in

Table 32, Figures 54 through 57, and Appendix E. Where data are missing for a cruise, that station was not sampled at that time by otter trawl.

The outside stations (l-4) displayed no consistent catch patterns over the sampling period (Figure 54). Greater weights per tow of demersal fish were taken at Transects 2, 3, and 4 in Cruise 1 (late June to mid-July). Cruise 3 (late August to mid-September) catches were a little higher in weight per tow on Transect 6 but this transect was not fished during Cruise 1 (Figure 54).

The average weight of fish caught in outside station otter trawls in all cruises by station and transect are presented in Figure 55. Transects 1, 3, and 6 all yielded high overall catches (> 6.2 kg per haul); Transect 5, the lowest catches (1.4 kg per haul, Table 32). The stations closer to shore (3 and 4) yielded heavier otter trawl catches on Transects 1, 3, and 6 (Figure 55). Catch at the outside station (2) was relatively greater than one (or both) of the inner stations at Transects 2, 4, and 5. Bottom type (soft versus harder bottoms) may be a greater factor than depth in shifting species dominance from generally larger flatfish on softer bottoms to generally smaller sculpins on harder bottoms. On Transect 5, rocky bottom conditions at some stations may have affected otter trawl efficiency. More fish may have been missed or lost than were captured because of problems encountered in trawling on harder bottom. Sampling inside embayments was not consistent, with only Transect 4 trawled during all cruises (Figure 56). Catches were greatest during Cruise 2.

Mean otter trawl catches are displayed by station for each transect (all cruises combined) on Figure 57. Station 3 yielded markedly higher catches than other stations on Transects 1, 2, and 6. Transect 4 had generally increasing catches of demersal fish as sampling moved closer in-shore (Stations 2 to 4) and continued to increase in inside waters (Stations 7 through 11). However, a similar pattern of increase in average weight per trawl did not hold for Transect 6. No inside stations were otter trawled at Transect 2 (Port Heiden).

TABLE 32

TOTAL FISH CATCH IN OTTERTRAWLS
(mean weight per set, grams)

Station	Cruise 1	Cruise 2	Cruise 3	Mean	Standard Deviation
Transect 1					
1.0					
2.0		1707.5	449.5	1078.5	629.0
3.0		19009.5	11549*0	15279.3	3730.3
4*G		9984.5	2816.5	6400.5	3584.0
5.0					
mean		10233.3	4938.3	7586.1	
std dev		7065.7	4773.3		

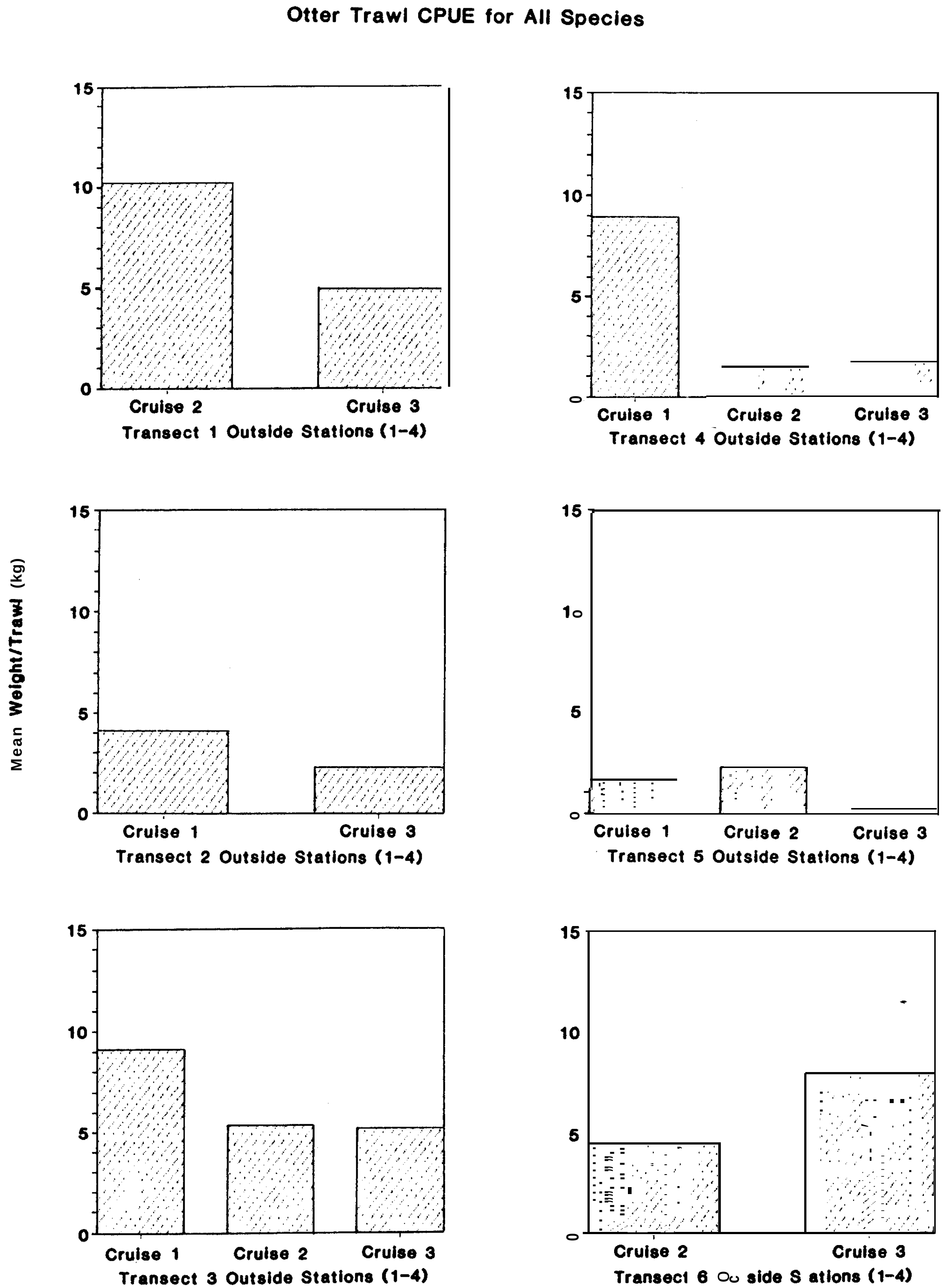
Station	Cruise 1	Cruise 2	Cruise 3	Mean	Standard Deviation
Transect 2					
1.0			1758.5	1758.5	0.0
2.0	2461.0		1194.0	1827.5	633.5
3.0	7730.0		5739.5	6734.8	995.3
4.0	2156.5		452.5	1304.5	852.0
5.0					
mean	4115.8		2286.1	3201.0	
std dev	2558.6		2046.9		

Station	Cruise 1	Cruise 2	Cruise 3	Mean	Standard Deviation
Transect 3					
1.0					
2.0	5864.0	1696.5	1787.5	3116.0	1943.5
3.0	3875.5	11737.5	5499.0	7037.3	3389.0
4.0	17584.0	2537.0	8297.0	9472.7	6198.9
5.0					
mean	9107.8	5323.7	5194.5	6542.0	
std dev	6048.3	4548.2	2666.2		

Station	Cruise 1	Cruise 2	Cruise 3	Mean	Standard Deviation
Transect 4					
1.0					
2.0	9230.0	1250.0	736.0	3738.7	3888.6
3.0	8614.0	459.5		4536.8	407'?.3
4.0	8953.0	2532.5	2618.5	4701.3	3006.6
7.0	8055.0	4710.0	2337.5	5034.2	2345.4
10*0	5527.0	23962.5	1235.0	10241.5	9859.2
11.0	14520.0	15723.5		15121.8	601.8
mean	9149.8	8106.3	1731,8	6329.3	
std dev	2692.4	8732,4	773.2		
outside stations	8932.3	1414.0	1677.3	4007.9	
	251.9	854.2	941.3		
inside stations	9367.3	14798.7	1786.3	8650.8	
	3786.8	7887.0	551.3		

Station	Cruise 1	Cruise 2	Cruise 3	Mean	Standard Deviation
Transect 5					
1.0					
2.0	35.0	4213.0		2124.0	2089.0
3.0	745.5	1056.0	25.0	608.8	431.9
4.0	4280.5	1659.0	560.0	2166.5	1560.7
5.0					
mean	1687.0	2309.3	292.5	1429.6	
std dev	1856.7	1368.4	267.5		

Station	Cruise 1	Cruise 2	Cruise 3	Mean	Standard Deviation
Transect 6					
1.0					
2.0		2636,5	3130.0	2883.3	246●E
3.0		3974.0	18260.0	11117.0	7143.0
4.0		7021.0	2578.0	4799.5	2221.5
7.0		4904.0	383.5	2643.8	2260.3
8.0		1245.5	1076.5	1161.0	84.5
9.0		3527.5	1698.5	2613.0	914.5
mean		3884.8	4521.1	4202.9	
std dev		1804.4	6210.5		
outside sta		4543.8	7989.3	6266.6	
		1834.8	7266.0		
inside sta		3225.7	1052.8	2139.3	
		1508.7	537.1		



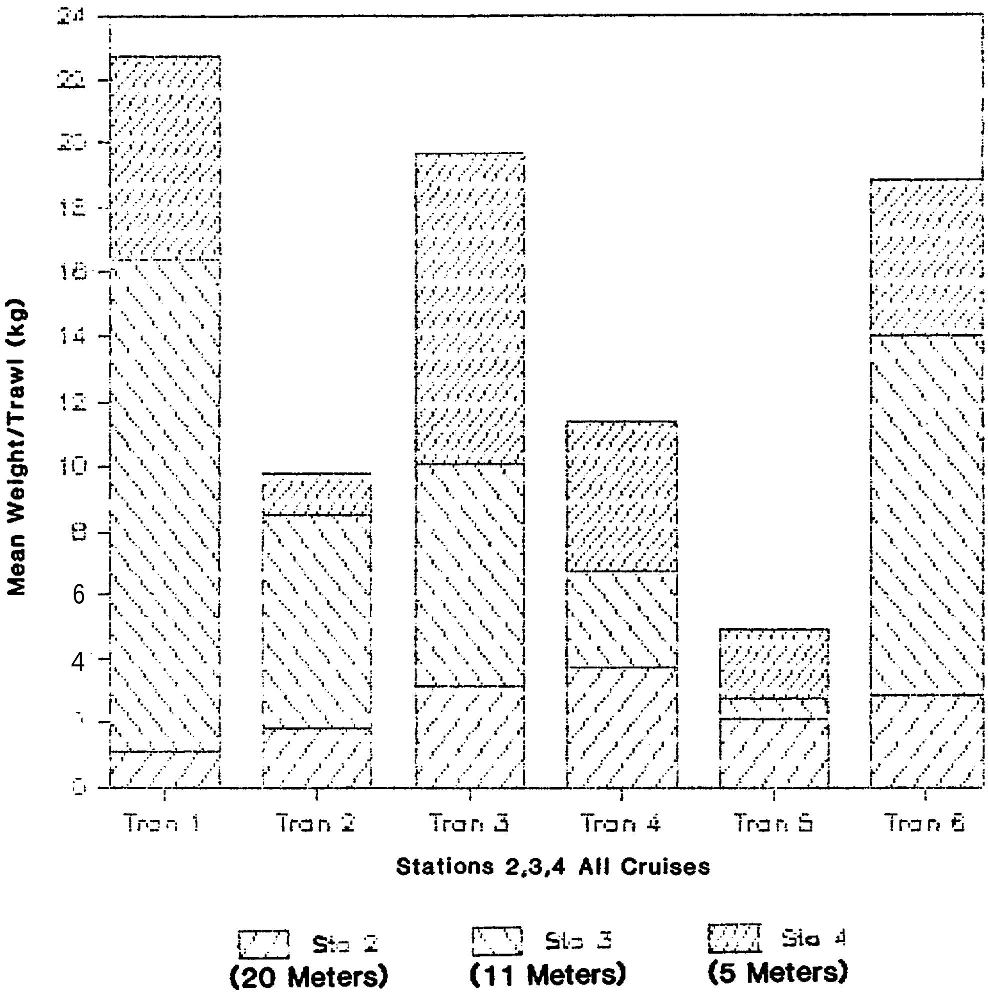
Mean Weight (kg) of Fish Taken in 1984 Otter Trawls

by Cruise at Outside Stations (1-4)

Dames & Moore

Figure 54

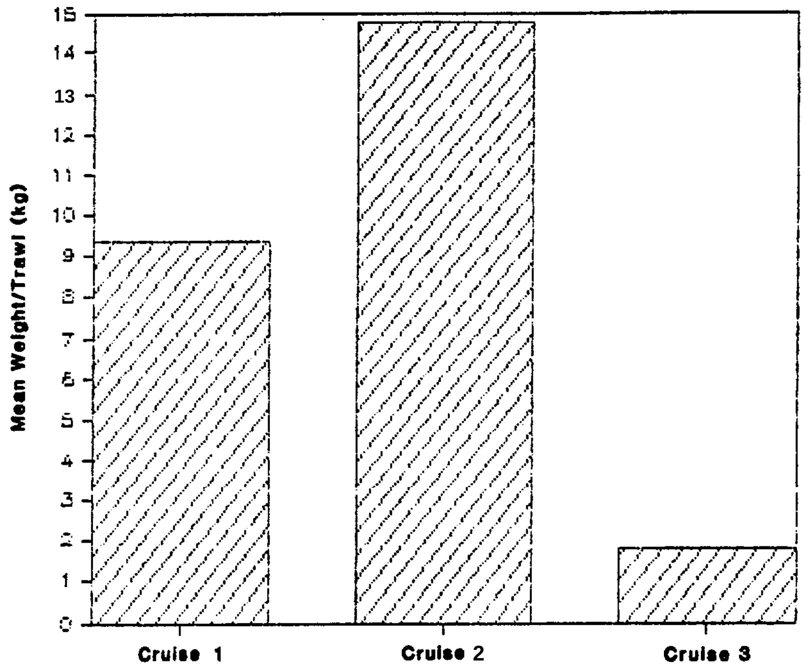
Otter Trawl CPUE for All Species



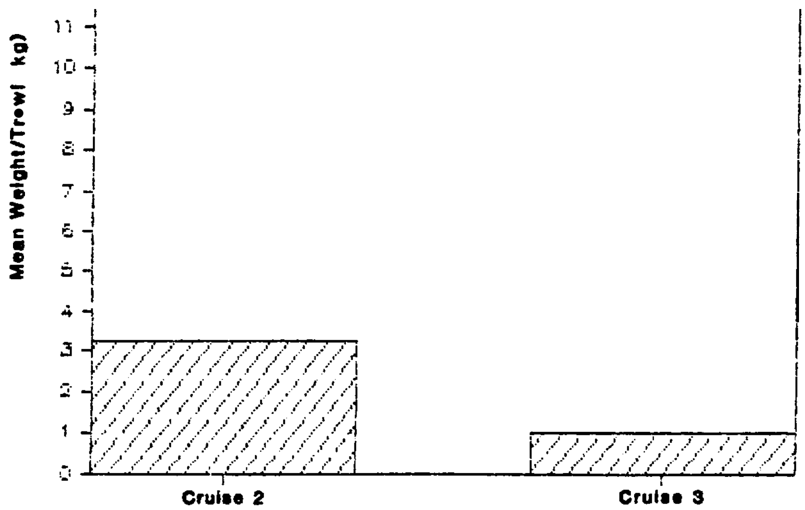
Mean Weight (kg) of Fish Taken in 1984 Otter Trawls by Transect for Stations 2, 3, and 4

(all cruises combined)

Otter Trawl CPUE for All Species



Transect 4, Inside Stations (7,t0,11)

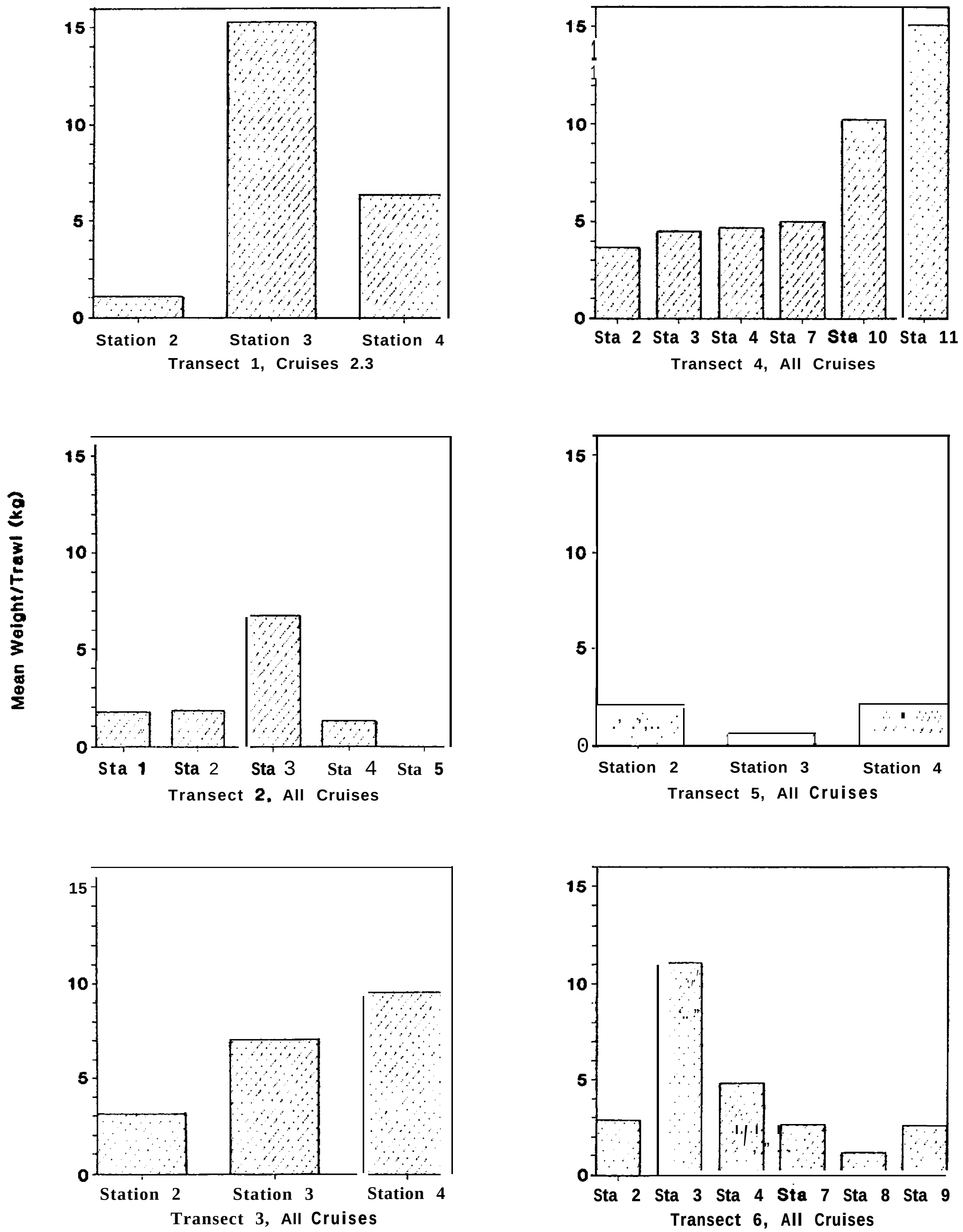


Transect 6, Inside Stations (7,8,9)

Mean Weight (kg) of Fish Taken in 1984 Otter Trawls by Cruise at Inside Stations

Dames & Moore

Fiaure 56



Mean Weight (kg) of Fish Taken in 1 984 Otter Trawls by Transect and by Station

Dames & Moore

Figure 57

All evaluations that follow are based on numbers, not weight of species caught.

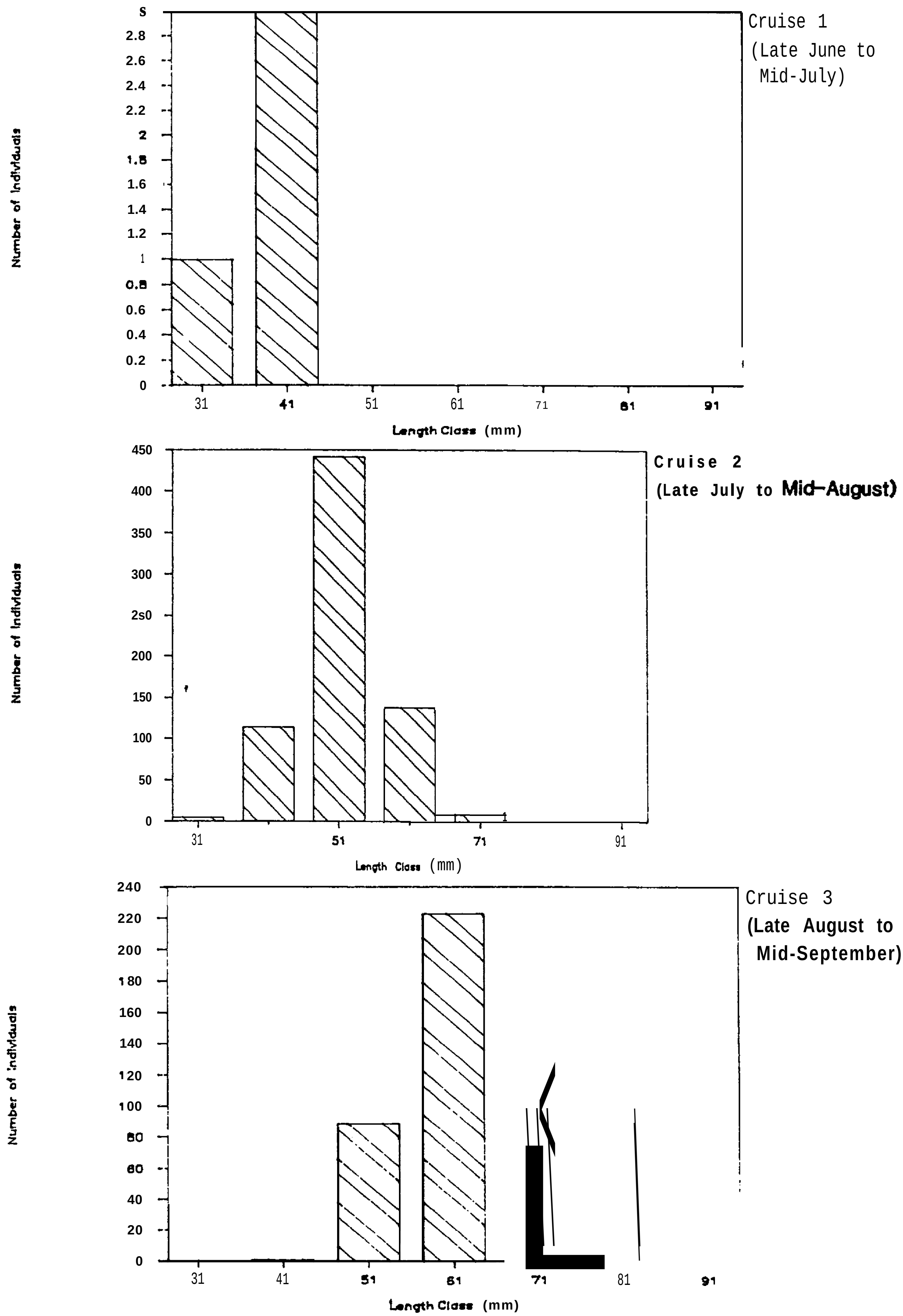
Pacific cod

The Pacific cod (Gadus macrocephalus) ranked fourth numerically, accounting for about 8 percent of our total 1984 catch in all gear. Cod were taken in the pelagic environment as well as on the bottom in about equal numbers overall, ranking first in purse seine and second in otter trawl catches (Table la). Many of the unidentified cod from Cruise 1 were probably this species, as well. Moreover, the numbers retained in the purse seine are but a small portion of those cod encircled in some sets. The small size of these fish (and the walleye pollock juveniles sometimes mixed with the cod), 30 to 50 mm (mean of 45.8 mm) in Cruise 1, often allowed more to pass through the seine web than were captured. The fewer numbers of Pacific cod taken in the otter trawl outweighed the purse seine catches of cod because individuals were generally larger.

Cod numbers in otter trawls increased with time in both inside and outside areas, although this may merely reflect increased retention of smaller fish in the gear (Figure 12). Outside stations had slightly higher average numbers of cod caught when compared with inside stations. As juveniles in the pelagic habitat, cod also were much more abundant in purse seine sets in Cruises 2 and 3 compared to Cruise 1 (Figure 9). By Cruise 3, the young-of-the-year cod were in the 50 to 80+ mm size range (mean of 66.9 mm in purse seines, Figure 58). No large Pacific cod (> 279 mm) were taken with the otter trawl in any cruise” indicating larger cod were either outside of our sampling area or missed by our small trawl.

Cod numbers were higher at outside (exposed) stations in inner bay (Transects 1 and 2) otter trawls, with middle and outer bay transects about equal with all cruises combined (Figure 13). At inside (protected) stations, Izembek Lagoon had slightly higher ‘catches of cod than did stations inside Port Moller.

In the pelagic environment, cod juveniles in purse seine catches were least abundant in the middle area (Transects 3 and 4).



Length-Frequency of Pacific Cod in Purse Seines, 1984
(all transects and stations combined)

Dames & Moore

Yellowfin sole

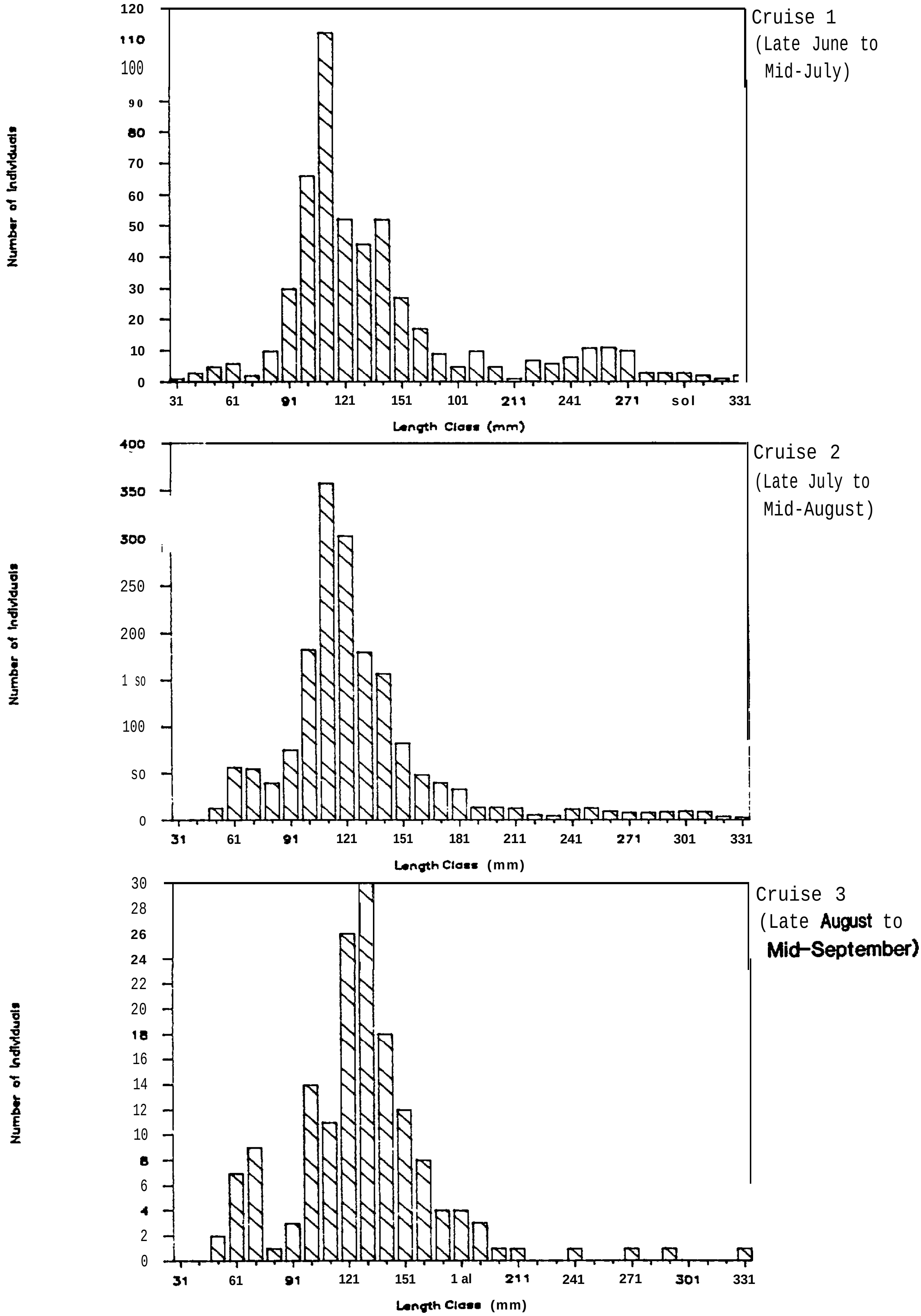
The yellowfin sole (Limanda aspera) was the most numerous fish in otter trawls and was the second (to Pacific sand lance) most numerous fish overall in 1984 (10 percent of all fish caught). In terms of weight, this species dominated every trawl set except for a few instances where several larger rock sole or a few large starry flounder dominated the weight of fish captured.

Yellowfin sole catches showed a slight (likely insignificant) downward trend by cruise, or with time, at both inside and outside stations. Catches in outside waters were quite similar in inner, middle, and outer bay areas (Figure 13). Of inside stations, yellowfin sole catches were higher in Port Moller than in Izembek Lagoon (no otter trawls were made in Port Heiden).

A broad range of sizes (< 50 to > 300 mm) of yellowfin sole was present in otter trawls from all cruises, both in inside and outside waters (Figures 59 and 60). Mean size of all yellowfin sole was similar in inside and outside otter trawls in Cruises 1 and 2, although the mode for the dominant year-class was smaller at the outside stations. Average size was distinctly greater at outside stations during Cruise 3, with the virtual absence of larger fish (> 200-m) from inside stations and a greater proportion of smaller size classes at outside stations. Three or four year classes were likely present at both inside and outside stations in Cruises 1 and 2, with only two likely present at inside stations in Cruise 3. Yellowfin sole in our otter trawls had mean lengths similar to those reported by Baxter (1976), but our catches included both larger and smaller fish than the range taken in his Bristol Bay sampling.

Rock sole

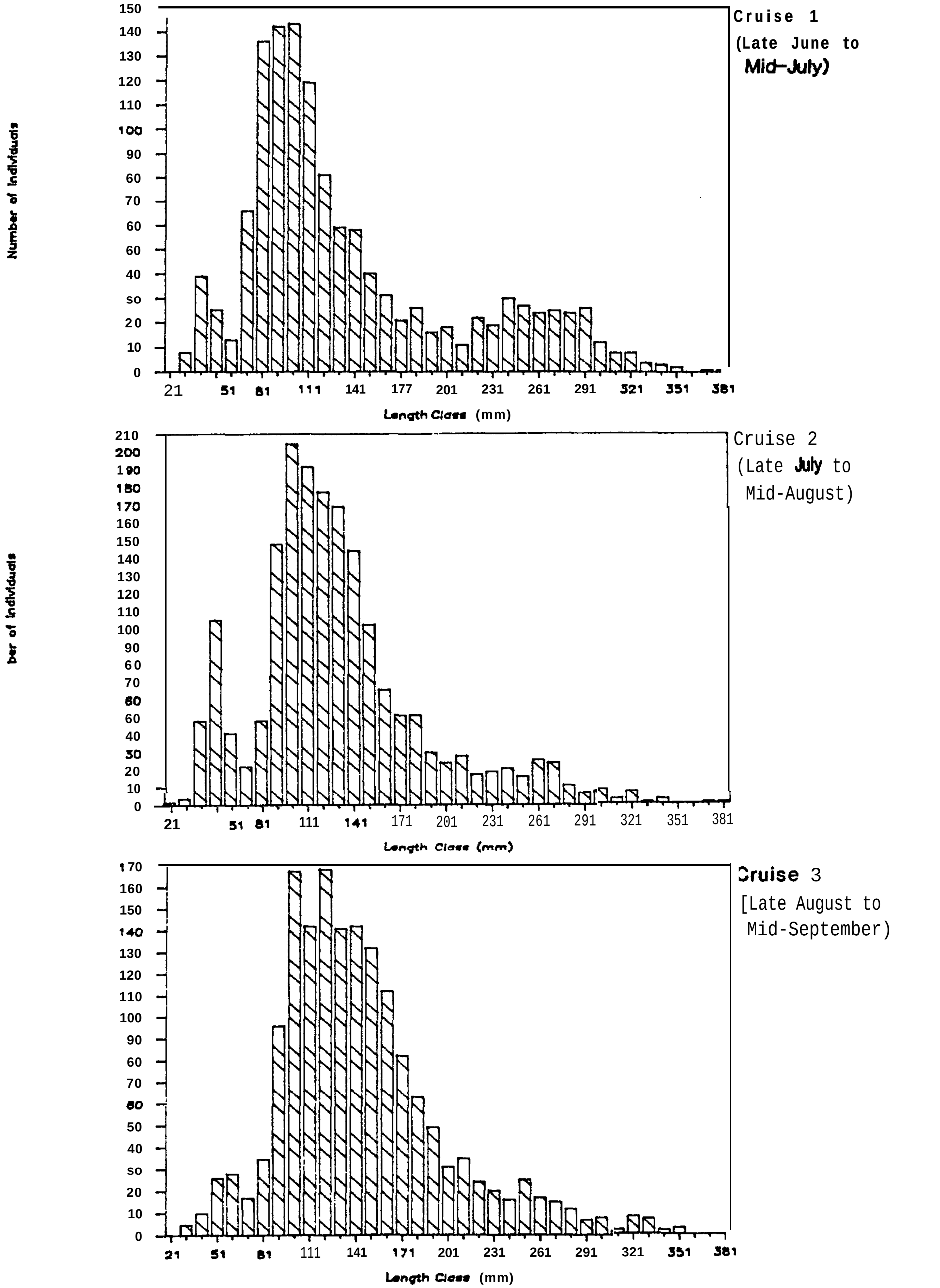
Rock sole (Lepidopsetta bilineata) ranked sixth numerically in our total 1984 catch for all gear types and third behind yellowfin sole and



Length-Frequency of Yellowfin Sole in Otter Trawls at Stations Inside Embayments, 1984
(all transects combined)

Dames & Moore

Figure 59



Length-Frequency of Yellowfin Sole in Otter Trawls at Coastal (Outside) Stations, 1984
(all transects combined)

Dames & Moore

Figure 60

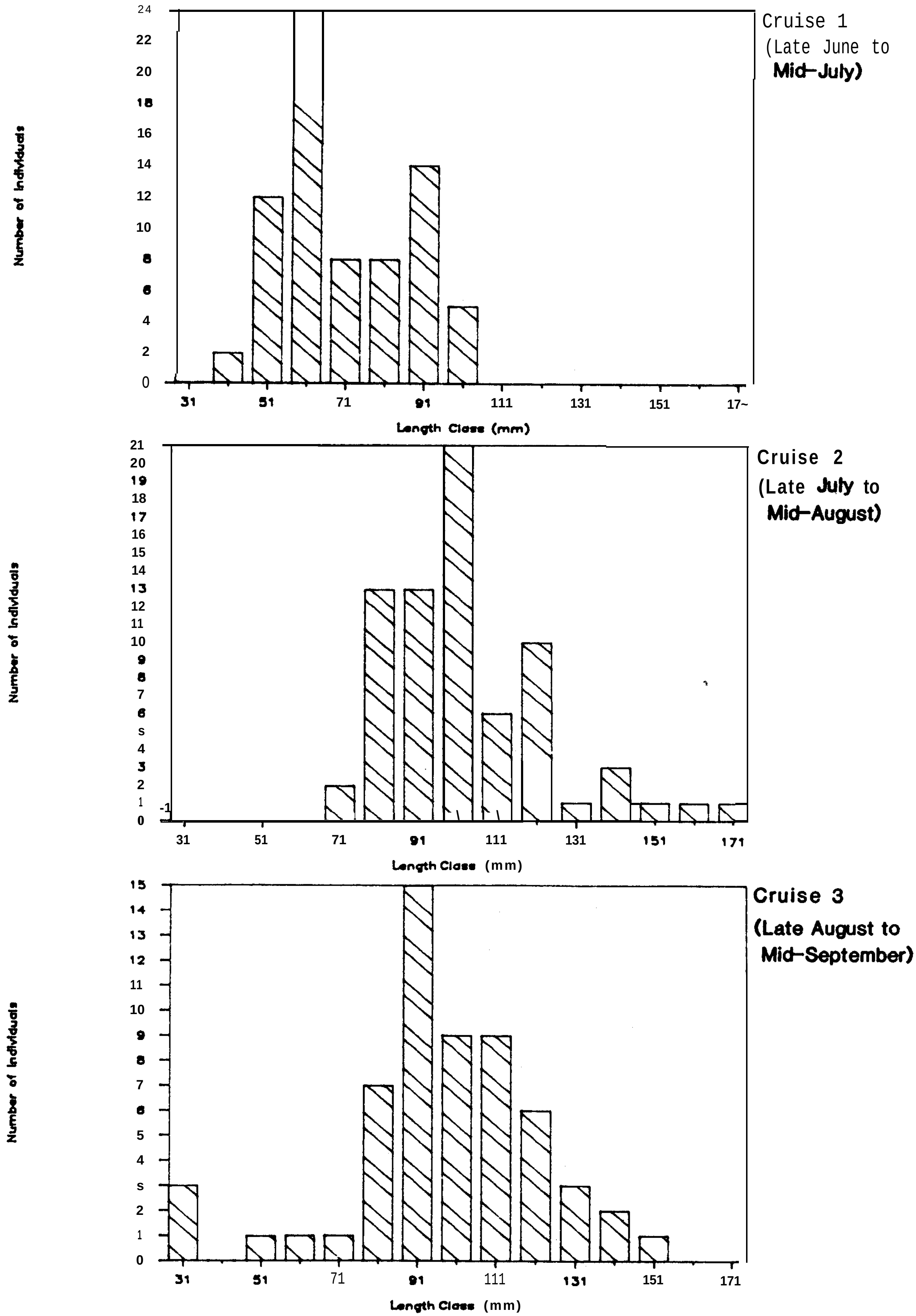
Pacific cod in otter trawl catches (Table la). As mentioned above, a few larger rock sole would often dominate specific trawls much like yellow-fin sole and starry flounder. Like yellowfin sole, this demersal species was taken incidentally in purse seine setsr and a small number was taken in beach seines (Table la).

Rock sole numbers in otter trawl catches declined with time especially at outside stations (Figure 12). Rock sole were somewhat more numerous in Cruise 1 and 2 inside stations as compared to outside stations. There was little difference in rock sole numbers caught between inner, middle and outer bay areas at outside stations.

No large rock sole (< 172 mm) were taken in any otter trawls at inside stations (Figure 61). During Cruise 1 this resulted in a much greater mean length at outside (93.3 mm) vs. inside (75.3 mm) stations. In Cruise 2 this difference in mean size was negated by recruitment of a new group of fish in the 25 to 40 mm size range at outside stations (Figure 62) where the size of all rock sole taken ranged from 25 to 331 mm (compared to a range of only 80 to 172 mm at inside stations). In Cruise 3, this smallest size class had recruited at inside stations as well (Figure 61). At outside stations it had merged with the broader dominant size mode (Figure 62), which likely contained three year-classes.

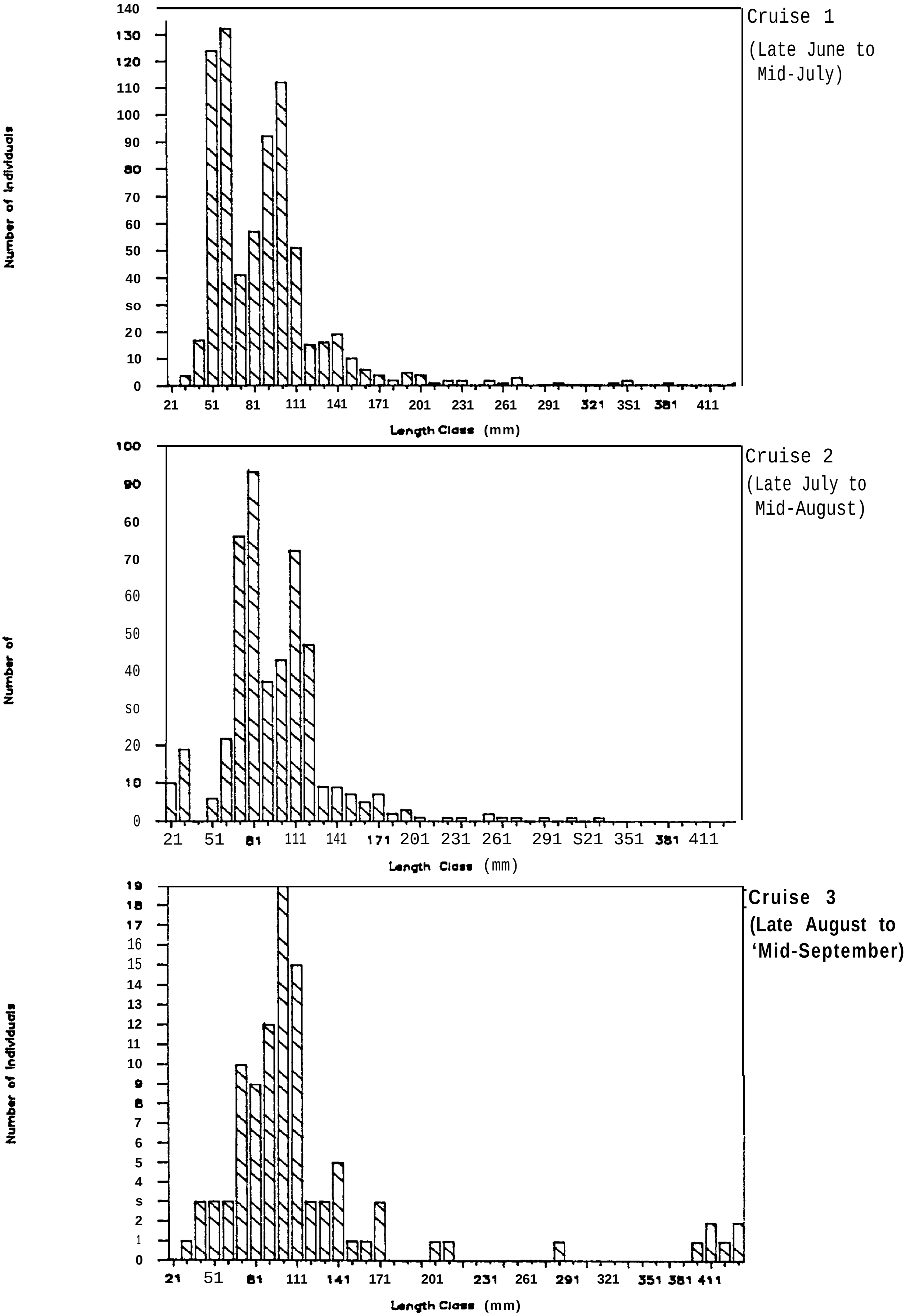
Whitespotted greenling

Whitespotted greenling (Hexagrammos stelleri) was among the top 10 species numerically in all four gear types in 1984 (third in purse seine catches, fifth in otter trawls, ninth in beach seines and tenth in tow nets). In purse seine catches, pelagic juvenile greenling were relatively abundant in the first two cruises (15 and 18 fish per set, overall average) but much less so (0.5 per set) in Cruise 3 (Figure 9). Purse seine catches generally increased from inner Bristol Bay to the outer transects. Beach seine catches increased steadily over the three cruises but were generally low (Figure 12). The largest beach seine catch (12 fish) was inside Ugashik Bay. Whitespotted greenling in both purse seine and beach seines were generally small (less than 85 mm) and showed no noticeable growth through the sample period.



Length-Frequency of Rock Sole in Otter Trawls at Stations Inside Embayments, 1984
(all transects combined)

Dames & Moore



Length-Frequency of Rock Sole in Otter Trawls at Coastal (.Outside) Stations, 1984
(all transects combined)

Dames & Moore

Figure 62

The demersal form of this species was widely distributed in otter trawls but was most abundant inside embayments in Cruises 2 and 3 and outside embayments on Cruise 3. Largest concentrations encountered were at less protected stations inside Port Moller and Izembek Lagoon on Cruise 2 and inside the mouth of Port Moller (Station 4) on Cruise 3.

Trawl-caught whitespotted greenling included at least two size classes. Early in the season (Cruise 1) only the larger size class (120 to 160 mm) was taken (Figure 63). The smaller size class (70 to 119 mm) was abundant at inside stations in Cruise 2. In Cruise 3, the smaller size class (80 to 130 mm) predominated at both inside and outside stations.

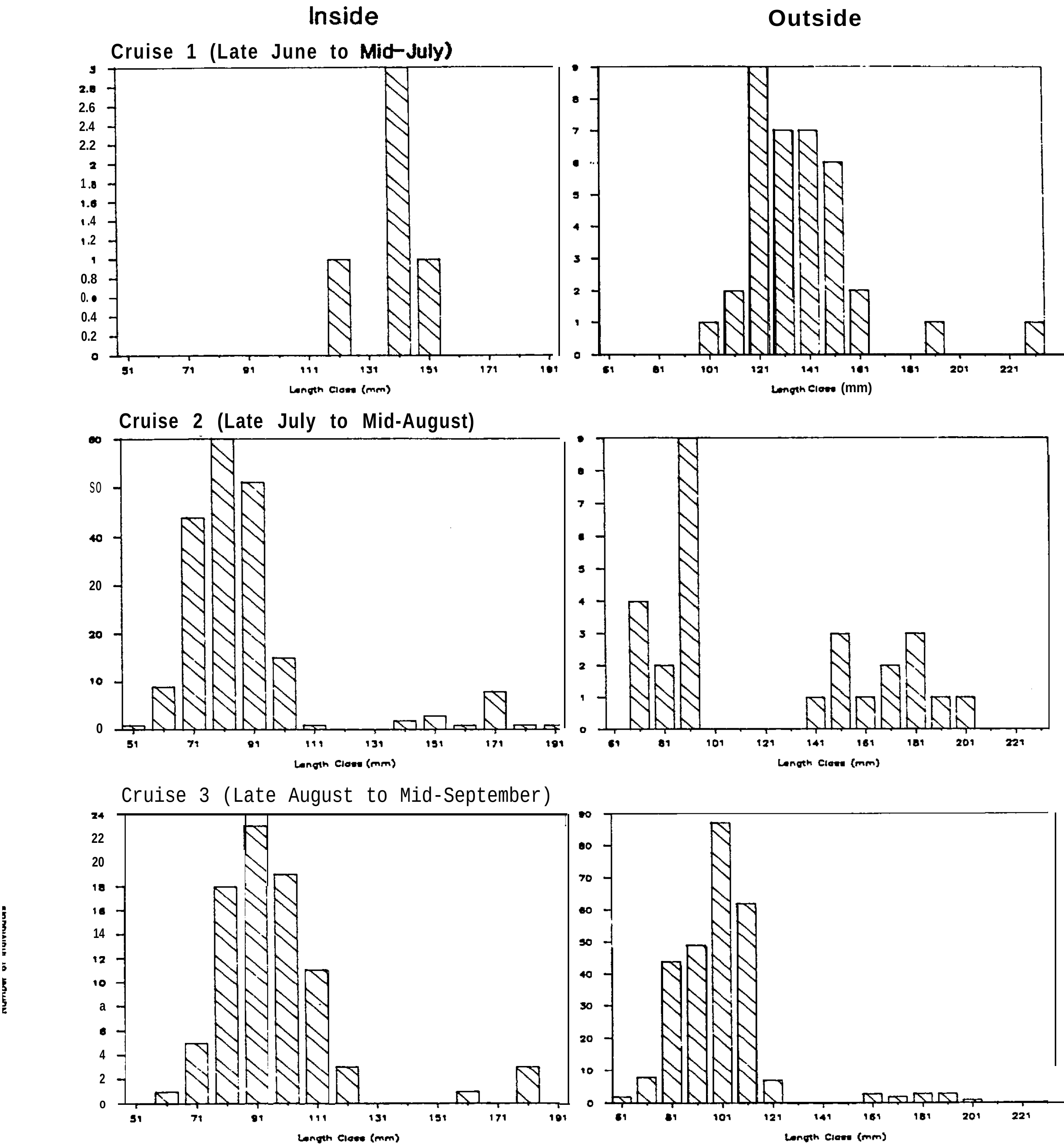
Walleye pollock

Like Pacific cod, walleye pollock were taken in both pelagic and demersal gear. Although it is generally considered a demersal species, walleye pollock ranked fourth in 1984 purse seine catches. Interestingly, this species was captured in the pelagic habitat only in Cruises 1 and 2 and only on Transects 3 and 5, transects removed from association with embayments. Pollock were also only caught at offshore stations. Greatest catches (303 and 169 fish) were in a set at the deepest station (27 m) and the shallowest station (11 m), respectively, seined on Transect 3 in Cruise 2. These fish were all in the 35 to 67 mm size range (mean 47.1 mm; n = 205).

Walleye pollock were scattered in otter trawl catches with a few fish in each survey. In Cruise 1 fish were taken on Transects 3, 4, and 5, while on Cruises 2 and 3 no pollock were taken south of Transect 3. Trawl-caught pollock tended to be substantially larger than purse-seine-caught fish. However, by Cruise 3, pollock in the 80 to 100 mm range began to dominate in otter trawls, perhaps recently undergoing the transition from pelagic to demersal iife style.

Pacific sandfish

Life history of the Pacific sandfish (*Trichodon trichodon*) does not appear to be well described (e.g., Hart 1973). In our 1984 catches,



Length-Frequency of Whitespotted Greenling in Otter Trawls at Inside and Outside Stations, 1984
(all transects combined)

Dames & Moore

Figure 63

sandfish were fairly widely distributed in purse seine and tow net catches (ranking fifth numerically in each) and were also taken in otter trawls. In purse seines, sandfish were taken in all cruises with greatest catch on Transect 3 (n-m station) in Cruise 1 and on Transect 6 in Cruises 2 and 3. Sandfish were of moderate size (100 to 200 mm) in Cruise 1, increasing somewhat by Cruise 2 (120 to 220 mm). By Cruise 3, larger sandfish were absent from purse seine catches and were replaced by a smaller size class (60 to 100 mm).

In tow nets, sandfish (112 to 212 mm) were only taken in Cruise 1 in replicate hauls on Transect 3, Station 4. Of all otter trawl catches, sandfish were most abundant (same size class) at this same station and time, demonstrating the overlap in these gear types at the shallower stations.

Starry flounder

Starry flounder (<u>Platichthys stellatus</u>) ranked fifth in 1984 beach seine catches but did not rank in the top 10 in otter trawls. This demersal fish species was generally close to shore as indicated by beach seine versus otter trawl catches. Occasionally, one or two large individual starry flounders would dominate beach seine or otter trawl sets on the basis of total weight captured. Despite not ranking in the top 10 numerically in total catch, starry flounder were included in Figures 12 and 13 since they appeared in all gear types and were of large size (to 522 mm) in some cases.

Starry flounder numbers in beach seines were comparable to the other flatfish graphed (Figure 12). They were fairly stable in numbers through the summer at outside stations but were noticeably more abundant at inside stations in Cruise 2. Both beach seine and otter trawl catches at inside stations peaked in Cruise 2.

Beach seines at protected stations had greater numbers of starry flounder in the inner bay (Port Heiden) as compared to the other two subareas. More starry flounder were caught at inside than at outside stations and none was taken in beach seines at exposed beaches on

Transect 5 or 6. Starry flounder numbers in otter trawls were small (generally less than two per haul), especially in the midbay subarea (Transects 3 and 4) at both inside and outer stations.

Beach seine-caught starry flounder included much smaller sized fish (to 40 mm) than did otter trawls. A strong mode in the 65 to 90 mm size was present in Cruise 1 beach seine catches, while Cruise 1 otter trawls took none smaller than 337 mm. No strong modes were present in otter trawl catches, although many fish were in the 330 to 360 range.

Alaska plaice

Alaska plaice (Pleuronectes quadrituberculatus) ranked sixth in otter trawl catches and ninth in total catch in 1984 (Table la). This demersal flatfish, like starry flounder, was taken in both otter trawl and beach seines, indicating some preference for nearshore shallow waters.

Alaska plaice were not taken in beach seines at inside stations during Cruise 1, and catches increased slightly from Cruise 2 to 3 (Figure 12). Numbers of Alaska plaice taken in beach seines at outside stations declined slightly from Cruise 2 to 3 with none taken in Cruise 1. In otter trawl catches, Alaska plaice were more abundant and numbers generally declined with time at both inside and outside stations.

No plaice were captured in beach seines at inside (protected) stations in the inner bay subarea (Figure 14). At outside (exposed) stations, beach seine catches of Alaska plaice were reversed with no catches in the outer bay and increasing numbers from middle to inner bay subareas. Otter trawl catches of Alaska plaice showed a strong pattern of reduced numbers taken from inner to outer bay subareas (Figure 13).

In Cruise 1 otter trawls, there were at least two distinct size classes of Alaska plaice, with modes in the 50 to 75 mm and 135 to 170 mm range. In Cruise 2, these two modes were less abundant with increased numbers of fish < 200 mm. By Cruise 3, the initial two modes had increased in size by about 15 to 20 mm and a new size class in the 35 to 50 mm range had appeared, especially inside Izembek Lagoon.

Bering poacher

Bering poacher (Occella dodecaedron) ranked seventh in 1984 otter trawl catches with a few caught in other gear types (Table la). This species did not rank in the top 10 in total numbers of fish caught by all gear types.

In otter trawl catches, Bering poacher appeared in greater numbers nearer to shore (Stations 2, 3 and 4) with small numbers near the beach (as indicated by beach seine catches). However, very few were taken inside embayments. There was little trend in otter trawl catch rate over time. They were substantially more numerous in the inner and middle bay compared to the outer bay subarea.

Otter trawl-caught Bering poachers tended to be larger at deeper water stations.

Snake prickleback

Snake prickleback (Lumpenus saqitta) ranked eighth in otter trawl catches based on numbers caught, but did not rank in the top 10 fish species taken in 1984 with all gear types (Table la). This species was also taken incidentally in all other gear types. Based on tabulated otter trawl catches this demersal species appears more numerous nearshore (Stations 4 and 3) and inside bays (Port Moller). Numbers increased steadily through the sampling period with the greatest catch (132 and 64 fish) in trawls from Station 4, Transect 1, on Cruise 3.

Snake pricklebacks were more numerous in inner and middle bay subareas as compared to the outer bay subarea.

Sizes of snake pricklebacks varied a great deal through the sampling period.

4.S.4 Discussion

By far the dominant forage fish in our 1984 catches was Pacific sand lance, which has not been reported as unusually abundant in earlier studies in the area (e.g., Baxter 1976, Barton et al. 1977, McMurray et al. 1984). Our results indicate heavy early July usage of protected coastlines in the study area by yearling sand lance, with lesser use of exposed coastlines. Larger sand lance (2-year fish?) were abundant in the pelagic habitat offshore. There was obvious growth of these two year-classes by midsummer (Cruise 2; Figure 52) along with an apparent shift away from the shorelines (reduced beach seine catches; increased tow net catches) within the embayments. By late summer, these size classes had largely abandoned beach areas and embayments and were increasingly abundant offshore in purse seine catches. However, a new size class (young-of-the-year?) which first appeared in beach seines in Cruise 2 was dominant in both shoreline (beach seine) and pelagic (purse seine) habitats in September.

Catches of rainbow smelt, the second most abundant pelagic species in 1984, exhibited some similarities with sand lance patterns and sizes. Rainbow smelt, however, tended to be more abundant on exposed than on protected beaches. Beach seine catches of smaller size classes of rainbow smelt generally increased through our entire sampling period while catches in purse seines declined; thus, there seems to be a more prolonged size segregation (smaller size classes remaining nearshore) in rainbow smelt than in sand lance.

Yellowfin sole domination of demersal fish communities in shallow waters north of the Alaska Peninsula, previously reported by many investigators (e.g., Baxter 1976, Cable 1981, Walters 1983, Grabacki 1984, McMurray et al. 1984), was certainly confirmed in our sampling. Our data indicate that by early July large numbers of yellowfin sole are present, with numbers gradually declining as summer progresses.

Our data also suggest a recruitment of young-of-the-year yellowfin and rock sole to coastal waters from offshore (cf., from local transformations from the planktonic to the demersal lifestyle). This is indicated by the relative dominance of the smallest size class taken in the otter trawls at our stations outside of embayments (Figures 60 and 62) versus inside stations (Figures 59 and 61). For example, with yellowfin sole, this smallest size class was more apparent at outside stations during Cruises 1 and 2, shifting to inside stations in Cruise

3. Many size classes of yellowfin sole were present inside and outside of the embayments sampled while larger rock sole were absent from otter trawls within embayments.

Thus, the inshore waters and embayments along the north shore of the Alaska Peninsula serve, at least seasonally, as nursery areas for several important pelagic and demersal species. There is an influx or a recruitment in size of juveniles during the spring and summer and a continued residence of subadult year-classes through the summer and early fall period. Presumably there is a major offshore movement of most of these species later in the fall. However, fish use of the study area from October through May has not been well studied.

4.6 NONSALMONIDS - 1985

4.6.1 General

Of the 25 identified non-salmon species (Dolly Varden are included here) taken in 1985, only 6 species are considered pelagic and 19 are considered demersal. As in 1984, the Pacific cod, Pacific sandfish, walleye pollock, and whitespotted greenling are considered demersal but were captured in the pelagic environment with the large purse seine. All representatives of these species except the sandfish were juveniles that are truly pelagic at this life stage. As noted above, adult Pacific sandfish make distant migrations from the demersal habitat with which they are usually associated. The small seine in 1985, and to a lesser extent the large seine in both years, sampled some shallow stations where true demersal species were taken in or near their actual habitats.

4.6.2 Pelagic Fish Species - 1985

"Pelagic" fish species dominated the 1985 catches in numbers caught with only 6 species of non-salmon taken. In terms of total number of fish caught, Pacific sand lance ranked first for all gear (Table lb) and made up 32 percent of the total 1985 catches. Rainbow smelt ranked fourth and made up 9 percent of the total catch in 1985. Whitespotted greenling, primarily juveniles in large purse seine catches, ranked eighth and made up 0.4 percent of the 1985 catches. Capelin ranked ninth and pond smelt ranked tenth with even smaller percentages of the total catch in 1985. Of the six non-salmon species considered pelagic only the Dolly Varden did not rank in the top 10 catches in terms of numbers caught in 1985. Pelagic nonsalmon dominated all gear types including the beach seine. Only the demersal starry flounder ranked in the top 5 in beach seine catches, and that species was in fifth place. The starry flounder ranked sixth in numbers of all fish taken in 1985 (Table lb).

The general distribution and observed size patterns of dominant 1985 pelagic species are described below.

Pacific Sand Lance

The Pacific sand lance was the most abundant fish taken in 1985 as it was in 1984. The catch of sand lance by gear type again indicated this species is highly adaptable to a wide variety of nearshore and offshore habitats and appears to be an extremely important forage fish in the study area.

Beach seines captured 86 percent of all sand lance taken in 1985 (Table lb). In Cruise 4a beach seine sets (Appendix I), the largest catches of sand lance were in the protected beaches of Port Moller (Transect 4), at Harbor Point (Station 6), and at Shingle Point (Station 8) in Herendeen Bay; average abundances were 671 and 253 sand lance per set, respectively. Both of these beaches have gradual slopes and are exposed to relatively little wave action. The substrate ranges from sands to small cobbles with some attached algae. No other transects were sampled by beach seine in Cruise 4a.

In Cruise 4b, sand lance were absent from all beach seine sets in Ugashik (Transect O) and all 6 sets in Port Heiden (Transect 2) possibly due to the greater fresh water influences on the beaches sampled (cf. Port Moller). Substrate was also fine grained (sand and muds), often with a lot of organic debris. On Transect 4 in the Port Moller area, sand lance were taken in Cruise 4b at all beach seine stations, with the greatest overall numbers at the more exposed and more steeply sloped Station 9 on the outside face of Shingle Point. Even the more exposed side of Harbor Point in Port Moller (Station 5) had small numbers of sand lance. Stations 5, 6, 8, and 9 had mean abundances of 92, 233, 227, and 352 sand lance per set, respectively.

In Moffet Lagoon (Transect 6), both beaches sampled are fairly protected from surf. However, Station 6 inside Operl Island is fairly dynamic with respect to tidal current velocities and had no sand lance. Station 7 located on a sand to mud bar on the north side of the Moffet Lagoon entrance had large numbers of sand lance (average abundance of 2102 fish per set) in four beach seine sets in Cruise 4b. The difference may have been in the shallower slope and the generally slower tidal currents very close to shore at Station 7, compared to Station 6.

The small purse seine (Appendix H) accounted for only 3.5 percent of the sand lance taken by all gear types in 1985 (Table lb). Five small seine sets in Port Heiden (Transect 2) captured no sand lance in Cruise 4a. Small numbers of sand lance were taken in Port Moller (Transect 4; 9 sets) at Stations 3 and 7, while no sand lance were taken at Station 4 off Harbor Point or at Station 13 in the entrance to Herendeen Bay.

In Cruise 4b, no sand lance were taken with the small seine at Transects O (3 sets) and 2 (1 set). At Port Moller (Transect 4; 13 sets), the stations on the outside and inside of Harbor Point had no sand lance in small seine catches, while one set (Station 12) had 322 fish, 96 percent of all the sand lance taken in 1985 with this gear. This single set in the inner part of Herendeen Bay was made on July 23. A small number of sand lance was taken in 1 of 3 sets in outer Herendeen Bay (Station 13). In Moffet Lagoon (Transect 6), no sand lance were taken in three small seine sets. These sets were made under high tidal current periods which may have influenced sand lance distribution or the efficiency of this gear type.

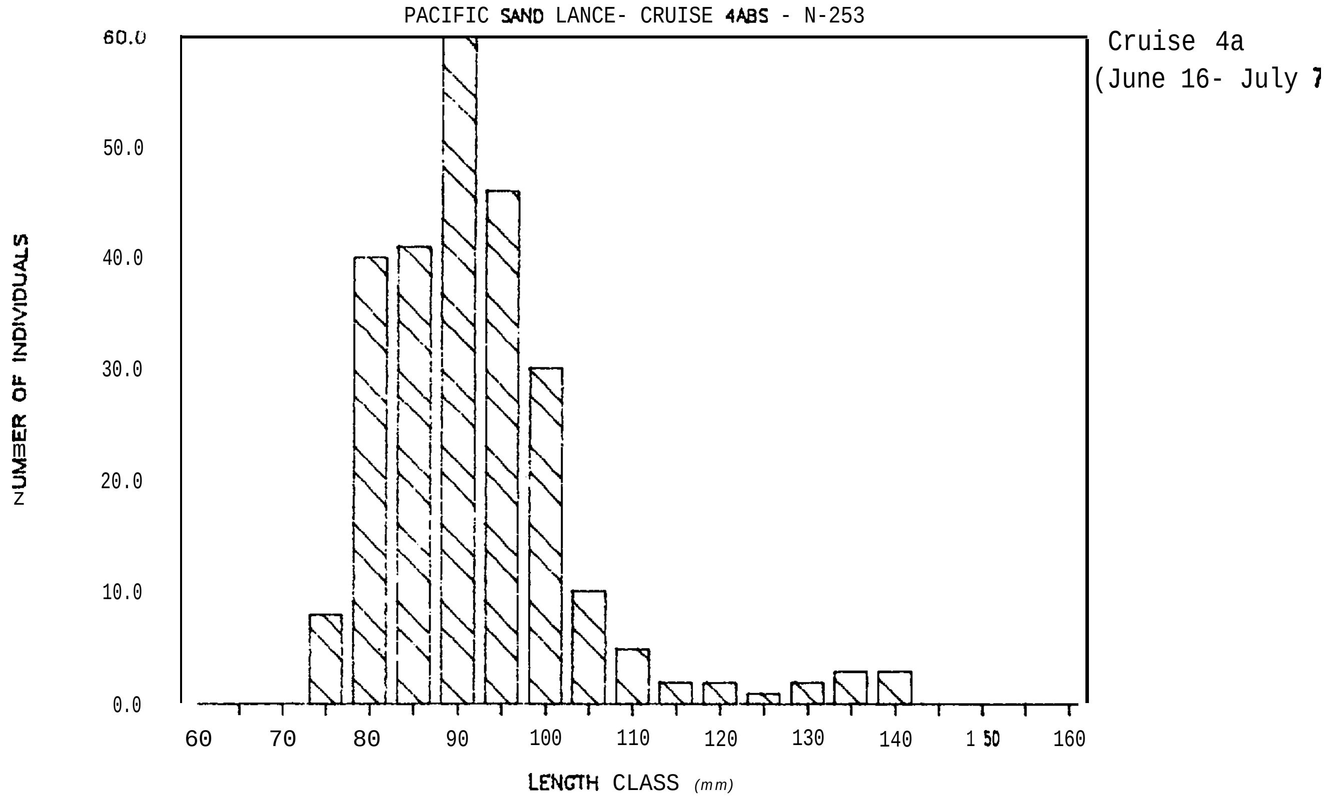
Approximately 10 percent of all sand lance taken in 1985 were captured in the large purse seine in the offshore stations (Table lb). In

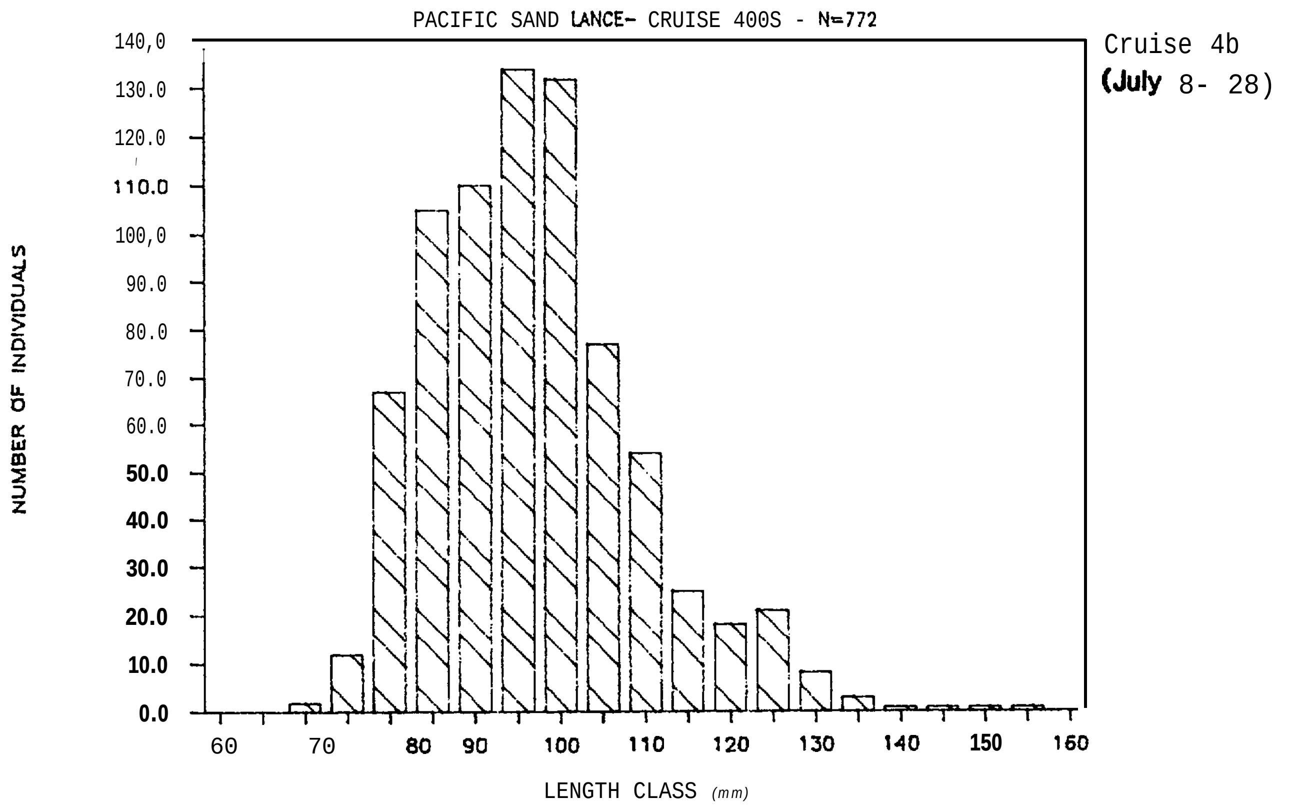
Cruise 4a, a few sand lance were taken in 1 of 3 sets each made at Stations O, 1, and 2 on Transect O (Appendix" G). Off Port Heiden (Transect 2), only one of two sets at Station 3 took a small number of sand lance (6 sets total). In Cruise 4a on Transect 4 (Port Moller), sand lance numbers increased as sampling moved closer to shore with mean catches of 2, 1.5, 61.4, and 106.8 fish per set at Stations O, 1, 2, and 3, respectively (16 sets, total). Cruise 4a large purse seine catches of sand lance on Transect 6 (Izembek Lagoon) exhibited this same pattern with reduced numbers of fish taken with distance offshore. The Station O, 1, 2, and 3 mean catches were O, 0, 8.8, and 12.4 fish per set, respectively.

Large purse seine sets in Cruise 4b took somewhat smaller numbers of sand lance at Transects 2, 4, and 6 while numbers increased slightly at Transect O. However, the Ugashik catches remained small with no fish taken at Station O and about equal numbers taken at Stations 1 and 2. Off Port Heiden (Transect 2), the only sand lance taken in 20 sets were at the most nearshore Station 3. As in Cruise 4a, the largest mean transect catch of sand lance in Cruise 4b was attained off Port Moller. The mean abundance in 10 sets at Stations O, 1, 2, and 3 on this transect was 0, 15, 117, and 1 sand lance, respectively. On Transect 6 (Izembek Lagoon) in Cruise 4b, only Station 2 of the four offshore stations for the large purse seine had a small catch of sand lance.

In summary, Pacific sand lance were fairly patchy in distribution in the 1985 catches; they were not consistent at any station on any transect with any gear type.

Length-frequency patterns for sand lance taken by beach seine in Cruises 4a (253 fish) and 4b (772 fish) are presented in Figure 64. The beach seine pattern shows some growth between Cruises 4a and 4b with a suggestion of two or three year-classes present near the beaches in the study area. (No ageing of any non-salmon was completed in the study.) Length-frequencies of sand lance taken by small seines nearshore in Cruises 4a (13 fish) and 4b (56 fish) (Figure 65) also suggest some

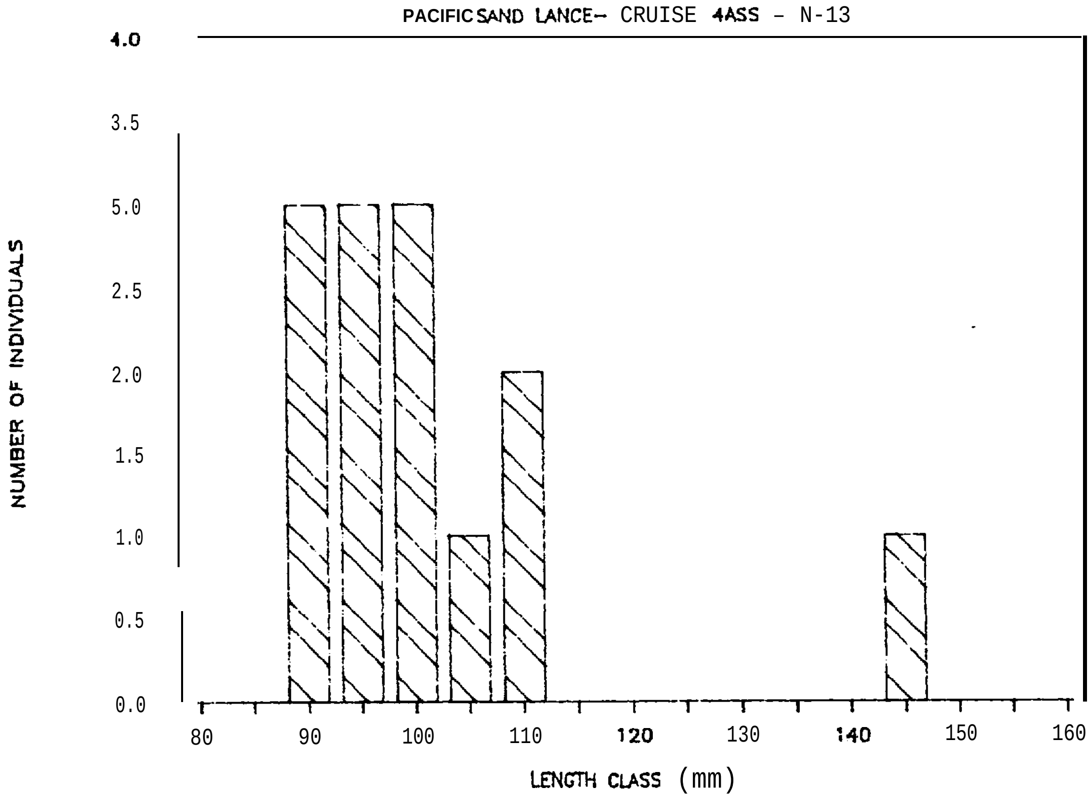




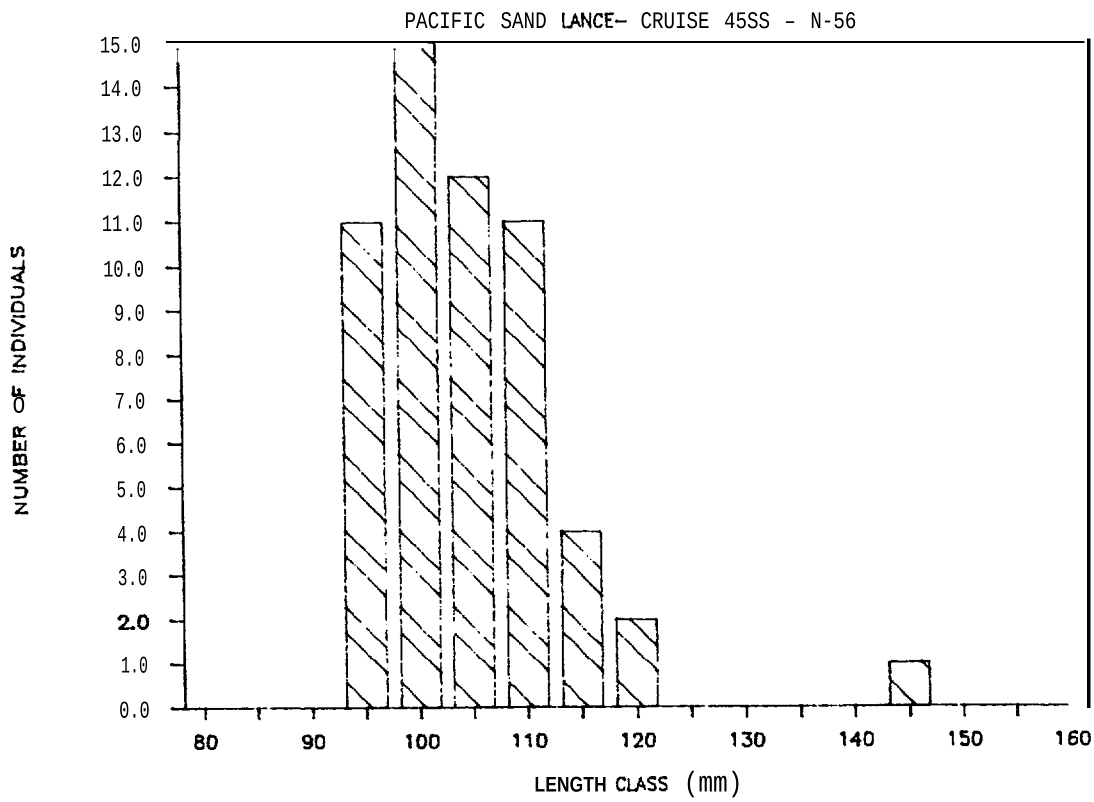
Length-Frequency of Pacific Sand Lance in Beach Seines, 1985

(all transects and stations combined)

Dames & Moore



Cruise 4a
June 16- July 7)



Cruise 4b
(July 8- 28)

Length-Frequency of Pacific Sand Lance in Small Seines, 1985

(all transects and stations combined)

Dames & Moore

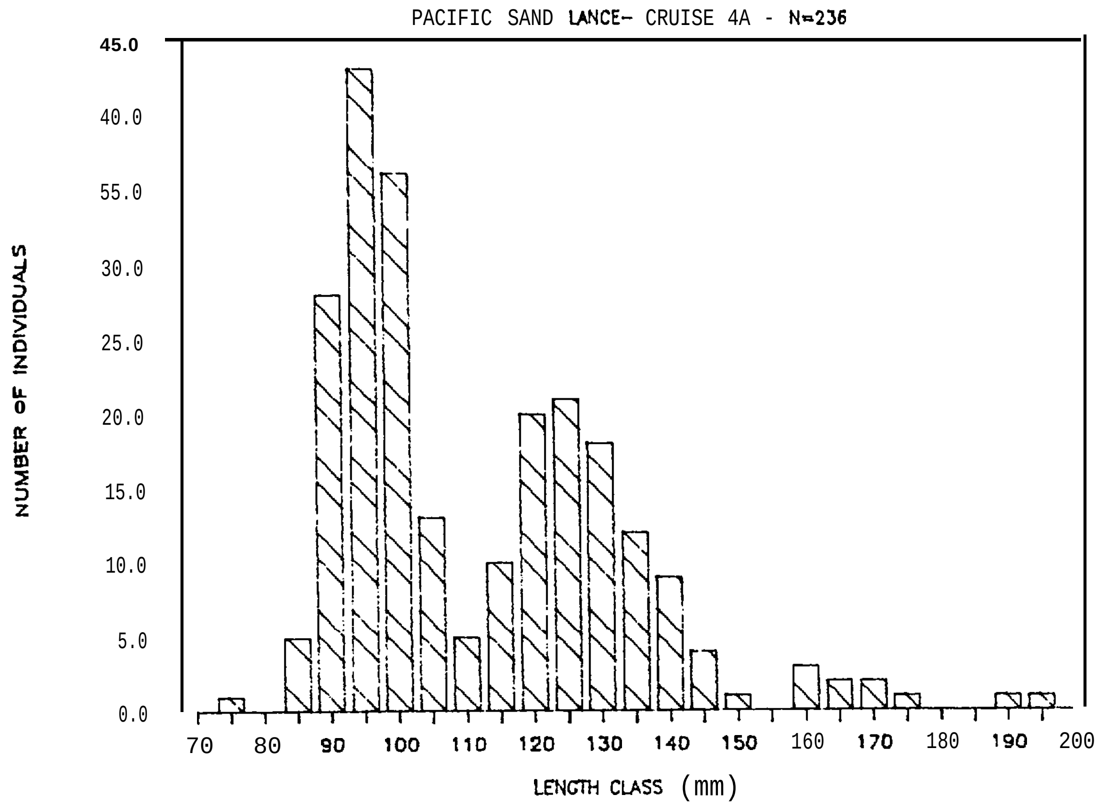
growth between periods. Length-frequencies of sand lance taken by large purse seine offshore in Cruises 4a (236 fish) and 4b (176 fish) (Figure 66) strongly indicated growth between cruises. There is also an apparent reduction in Cruise 4b of the frequency of the second and possibly the third largest modes from Cruise 4a. These 130± and 165± mm fish in Cruise 4a are either moving out of the study area or being selectively consumed by other animals. There are likely 3 or 4 year-classes in the large seine data.

If all three gear types are compared for the size of Pacific sand lance taken in 1985, some interesting patterns are present. In Cruise 4a, the 90- to 100-mm size class is apparent in all three study locations (offshore, nearshore and beach). However, the 130± and 165± mm size classes seen offshore in the large purse seine are not apparent nearshore and are diminished near the beach. When all gear in Cruise 4b are compared, a similar pattern of larger fish with distance offshore is evident. Since different gear are compared here, some caution is needed in that we may be seeing the result of gear selectivity since larger sand lance may be able to escape the small purse seine and the beach seine. However, the beach seine did appear capable of capturing a few fish in the 140- to 155-mm range.

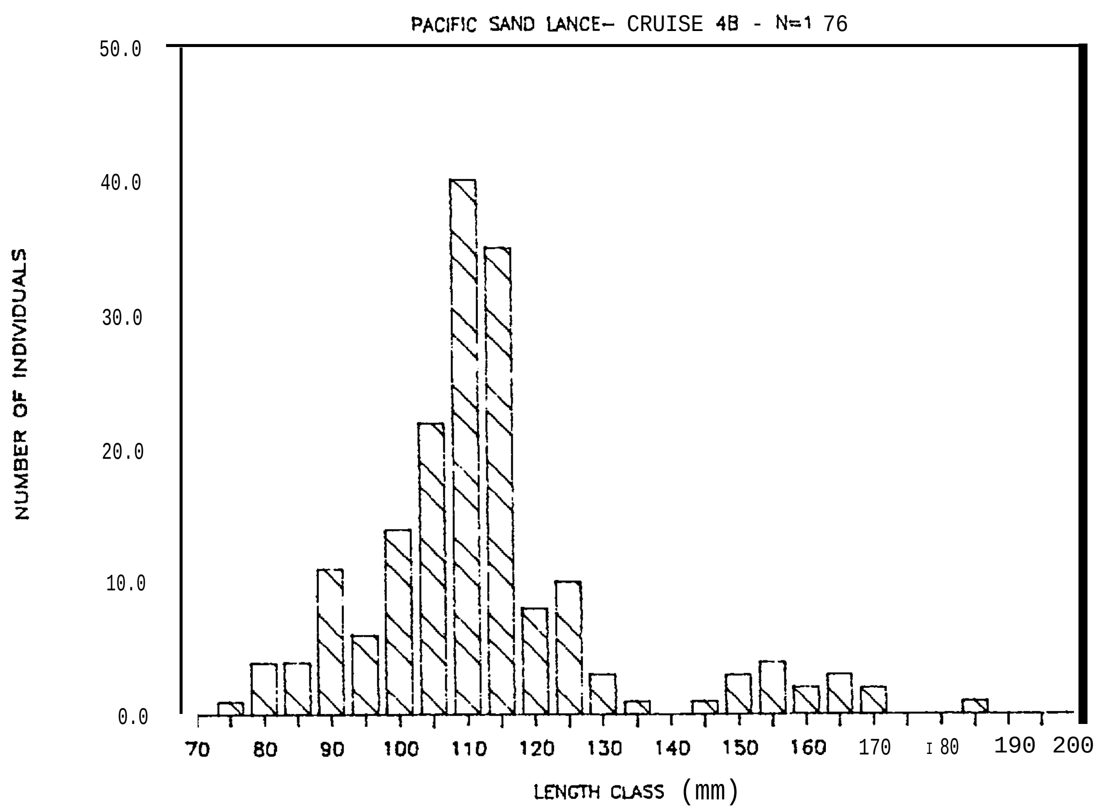
Rainbow Smelt

The rainbow smelt was the second most abundant nonsalmonid in 1985 and ranked fourth in overall fish catches in 1985 (Table lb). The rainbow smelt catch was 9 percent (by number) of all fish taken. The beach seine and small seine accounted for 74 and 25 percent of all rainbow smelt taken, reconfirming this species' affinity for beach and shallow nearshore environments.

In Cruise 4a, the beach seine catches (Appendix I) varied a great deal at Transect 4 (Port Moller), the only area beach seined in this cruise. The mean abundance of this smelt at Stations 5, 6, 8, and 9 was 35.7, 1, 0, and 8 per set, respectively (10 sets, total). Stations 5



Cruise 4a
June 16- July 7)



Cruise 4b
(July 8- 28)

Length–Frequency of Pacific Sand Lance in Purse Seines, 19&5

(all transects and stations combined)

Dames & Moore

and 9 are located on the the steeper, generally coarse (sand-to-cobble) substrate beaches that usually have the higher wave action at Harbor Point (Port Moller) and Shingle Point (Herendeen Bay). This pattern for rainbow smelt is the opposite of that discussed above for Pacific sand lance, which were more numerous at Stations 6 and 8 in this same cruise period.

In Cruise 4b, Transect O (Ugashik) beach seine sets at Stations 4, 5, and 7 had mean abundances of rainbow smelt of 95.5, 9.7, and 131.5 per set, respectively. Station 4 is on the outer coast outside Smoky Point, while Station 5 is on Smoky Point, and Station 7 is inside Dago Creek's small estuary. This pattern is confusing since Station 4 is very exposed and Station 7 is fairly protected. The key variable may be the more steeply sloped sand beach at Station 5. All three areas are sand beaches with the lowest sloped, most protected area at Station 7.

In Cruise 4b, Transect 2 (Port Heiden) beach seine sets at Stations 5 and 6 had mean abundances of 204.7 and 267.7 rainbow smelt per set. The somewhat higher catches were in the more protected area (Station 6) which is the so called "marina" for local gill net vessels. This area was gently sloped with a fine sand-to-mud bottom, while the more exposed Station 5 beach was a somewhat steeper sand beach. Numerical comparisons for this and other fish species may be complicated by the light mud at Station 6 and the large amount of organic debris in Station 5 which influenced the effectiveness of the beach seine. The problem was less in catching fish than in finding them in the mud or debris in the net once a set was completed. Smaller smelt and other fish species may have been missed in removing the catch from the nets. With the exception of eelgrass problems at Transect 6, no other beach seine sites approached the debris problems at Port Heiden.

In Cruise 4b, the largest beach seine effort (14 sets) was at Port Moller where Stations 5, 6, 8, and 9 had mean abundances of 4, 4.5, 0, and O rainbow smelt per set, respectively. One can only conclude that rainbow smelt numbers declined overall on the Port Moller beaches by Cruise 4b in 1985.

In Cruise 4b at Moffet Lagoon (Transect 6), no rainbow smelt were taken at Stations 6 and 7 in 4 beach seine sets.

On beaches sampled in 1985, rainbow smelt were most abundant at Port Heiden and were very consistent in beach seine catches there and at Ugashik. Rainbow smelt were much less abundant on Port Moller beaches than farther upbay at Transects O and 2 in Cruise 4b.

The small seine took 25 percent of the total rainbow smelt catch in 1985 (Appendix H). In Cruise 4a, 5 sets on Transect O (Ugashik) captured no smelt. In this same cruise, 9 sets on Transect 4 (Port Moller) captured rainbow smelt only at Station 7 (mean abundance, 9.3 fish per set in 3 sets) located well inside the bay behind Anchor Point. Transects O and 6 were not sampled with the small seine in Cruise 4a.

In Cruise 4b, the small seine was fished at all transects and was much more successful on rainbow smelt. Single sets at Transect O (Ugashik), Stations 8, 9, and 10 took 105.6, 276, and 236.2 smelt, respectively. All of these stations are inside Ugashik Bay with Stations 8, 9, and 10 located in the outer, middle and inner parts of the bay. Based on these limited data, rainbow smelt were least abundant in the most seaward station in the bay.

At Transect 2 in Cruise 4b, the single small seine set at Station 4 yielded no rainbow smelt. At Transect 4 in this same cruise, Stations 4, 7, 12, and 13 had mean abundances of 0.9, 20.4, 0, and O smelt per set, respectively. The more protected bay inside of Harbor Point (Station 7) had by far the largest concentrations of rainbow smelt in pelagic habitats inside Port Moller. These smelt concentrations were still quite small relative to those on the beaches in this area. At Transect 6 in Cruise 4b, 3 small seine sets captured no rainbow smelt.

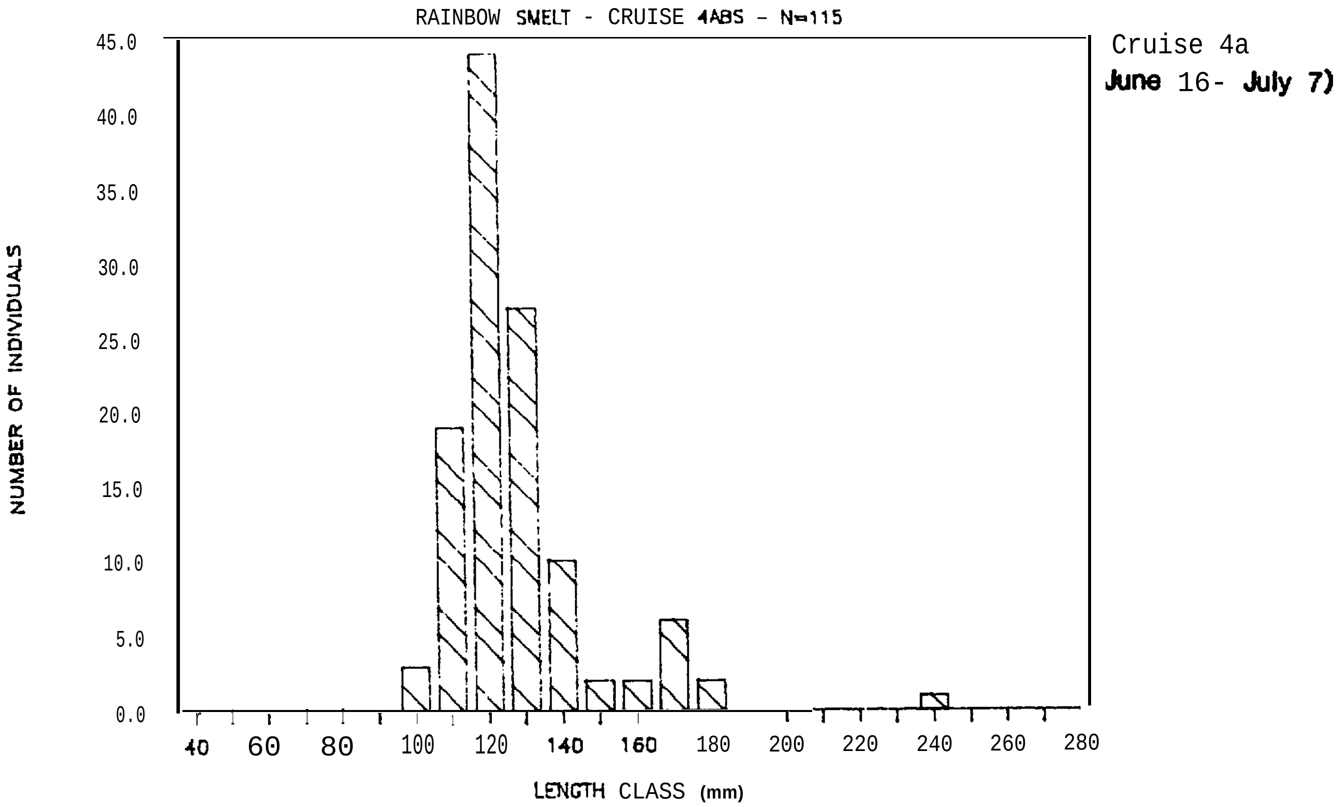
Rainbow smelt were very poorly represented in large purse seine catches (13 fish in 97 sets) indicating very low numbers at offshore stations in the study area. The few rainbow smelt taken with this purse seine were captured in both Cruise 4a and 4b at Station 3 on Transect 2 (Appendix G). This is the nearest offshore station and these small catches are consistent with the large catches of these smelt on Port Heiden beaches and the moderate catches of smelt with the small seine in adjacent nearshore waters.

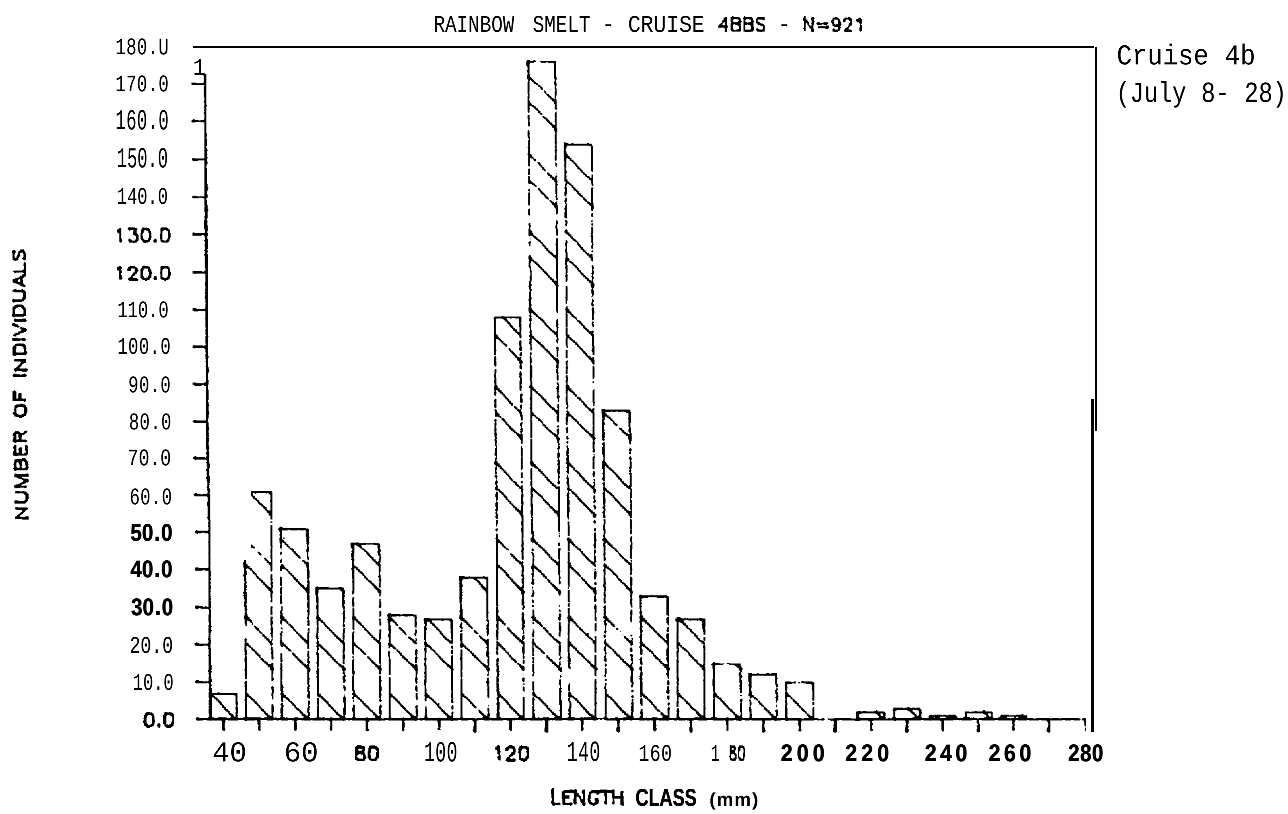
To provide some insights into the size patterns of rainbow smelt in 1985, Figure 67 presents the length-frequency patterns of fish taken in the beach seine in both Cruise 4a (115 fish) and 4b (921 fish). Some growth is apparent in the shift of the peaks between Cruise 4a and 4b. Although by no means clear, three-year classes may be present in rainbow smelt from Cruise 4b beach seines. Figure 68 presents the rainbow smelt length–frequencies from the small seine in Cruise 4a (10 fish) and Cruise 4b (382 fish). While the sample size is very small for Cruise 4a small seines, there is a hint of some smaller fish recruiting to the nearshore areas sampled in 1985 by Cruise 4b. TWO or possibly three year classes of smelt are suggested in Cruise 4b small seine catches.

In comparing catches in Cruise 4a, and recognizing the small sample sizes, there is an indication that larger fish are near shore but not adjacent to the beach. This pattern is not maintained in Cruise 4b, where greater numbers of smaller rainbow smelt seem to be near shore than adjacent to the beach.

Whitespotted Greenling

As adults, whitespotted greenling are demersal fish. However since over 94 percent of the 1985 catch of this species (128 fish) were juveniles taken in the large purse seine, this species is included in this pelagic fish section. This greenling ranked third in the "pelagic" fish group but only ranked eighth in total catch in 1985 (0.4 percent). Too few whitespotted greenling were taken in the small seine and beach seine to make any comments about distribution except to say they were apparently not very numerous nearshore in Cruises 4a or 4b. The few fish taken in the 39 large purse seine sets in Cruise 4a (Appendix G) were taken on Transect O Station O, Transect 2 Station O, and most were at Transect 6, Stations O, 1, and 3. No greenling were taken on Transect 4. This pattern in Cruise 4a tends to indicate these juveniles were offshore and in the more southern part of the study area, suggesting a source to the southwest of the study area.





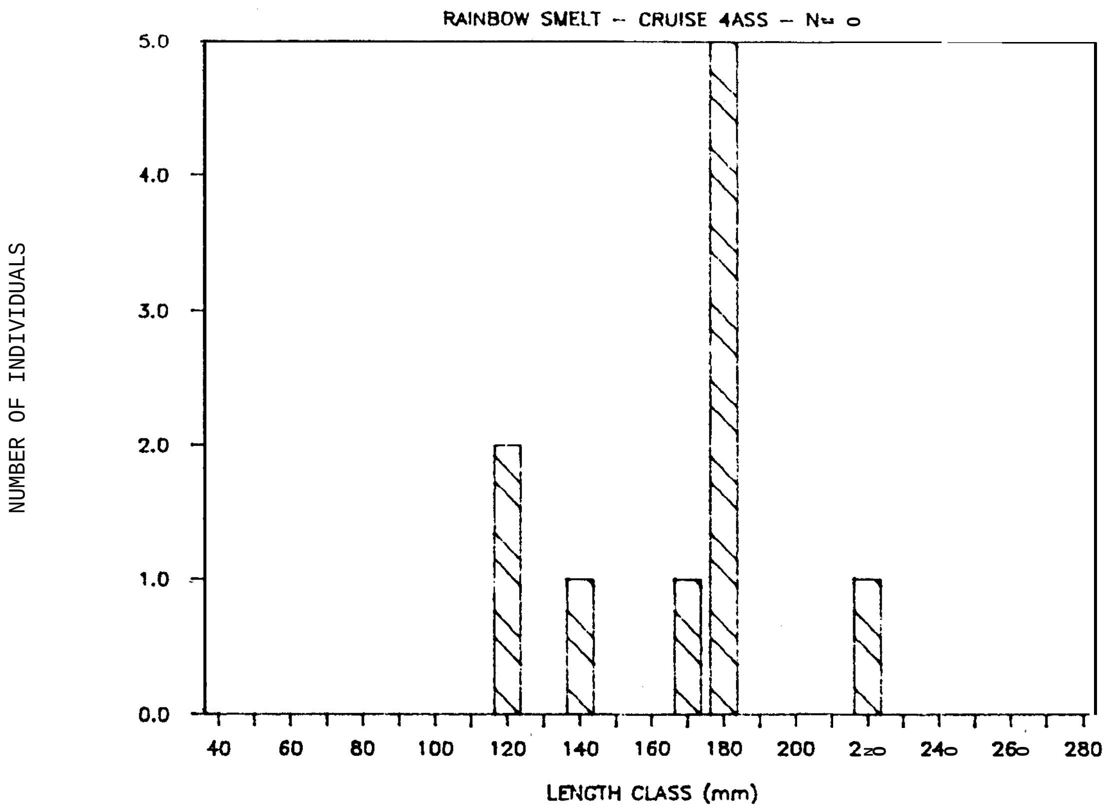
Length-Frequency of Rainbow Smelt in Beach Seines, 1985

(all transects and stations combined)

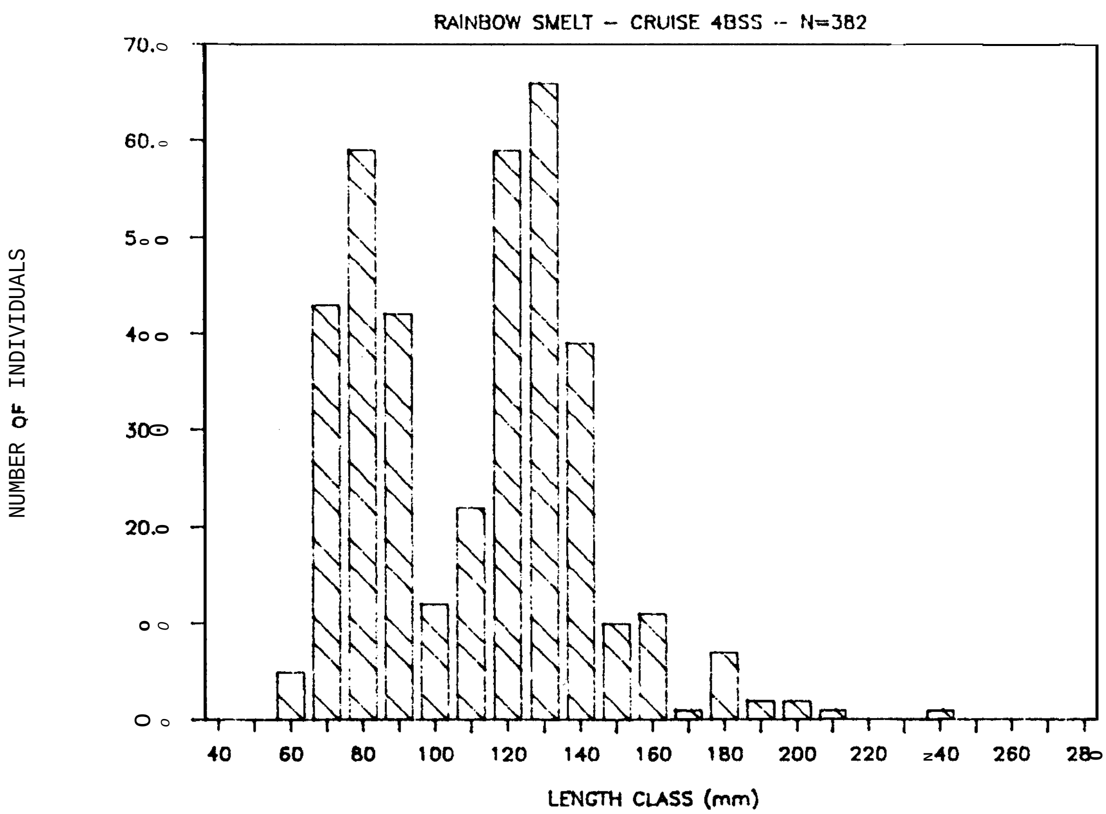
Dames & Moore

Figure 67

Cruise 4a
June 16 – July 7



Cruise 4b
(July 8 – 28)



Length–Frequency of Rainbow Smelt in Small Seines, 1985

(all transects and stations combined)

Dames & Moore

Figure 68

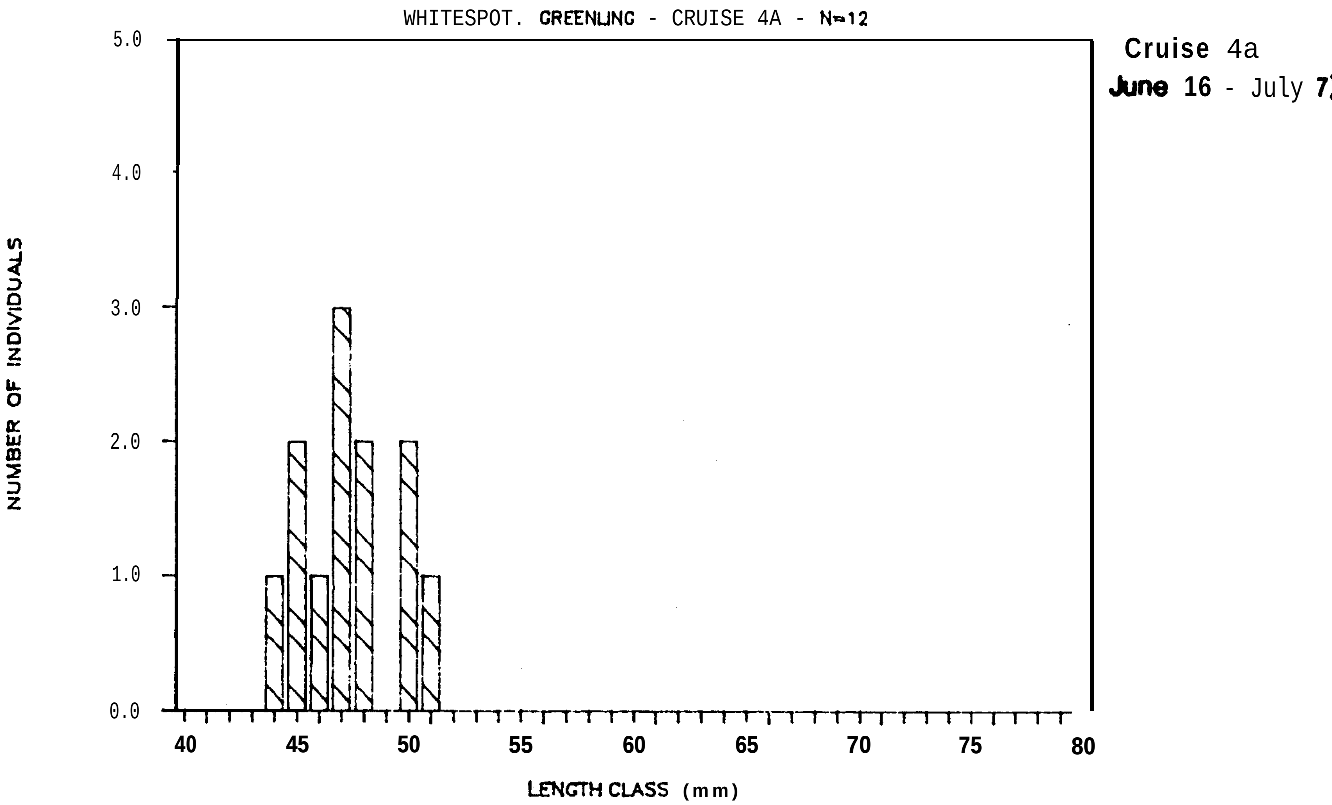
In Cruise 4b, whitespotted greenling were more evenly distributed between transects, although Transect 6 again had a slightly higher average catch with the large seine. At Transect O they were caught at Stations O and 2, but not at Station 1 (20 sets, total). At Transect 2, Station O, 1, 2, and 3 large purse seine sets (20 sets, total) had mean abundances of 3.9, 2.1, 0.9, and 9.7 fish, respectively. At Transect 4 in this cruise, the Station O, 1, 2, and 3 large seine sets (10 sets, total) had mean abundances of 1, 5.3, 6.6, and 1 fish, respectively. At Transect 6 in Cruise 4b, the Station O, 1, 2, and 3 large seine sets (8 sets, total) had mean abundances of 1, 4, 9, and 7 greenling, respectively.

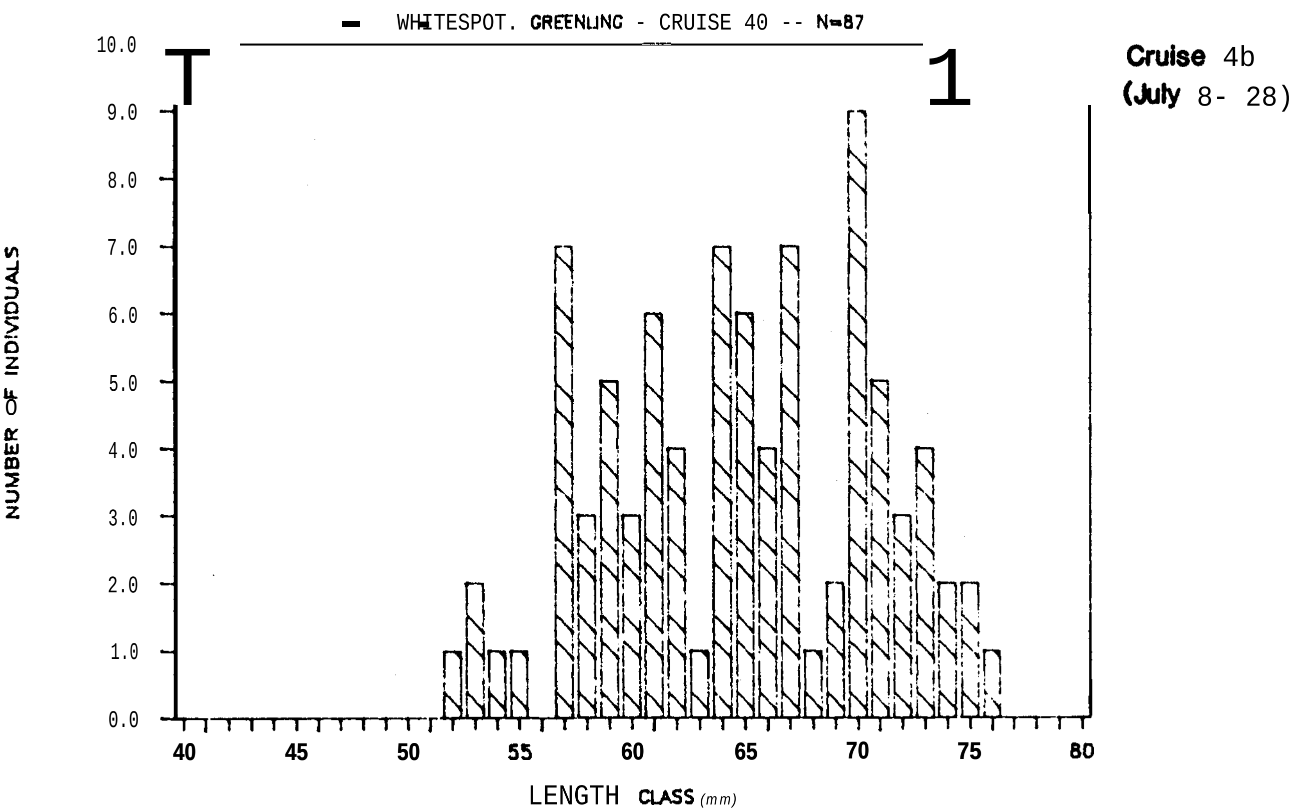
In 1985, whitespotted greenling were definitely more abundant in Cruise 4b than in 4a. These greenling were also more uniformly distributed offshore of the coast in Cruise 4b with some suggestion, although the numbers are small, of more fish inshore in Cruise 4b than in Cruise 4a large purse seine sets. Care must be taken in assessing these numbers as these are small fish that may, at their youngest age in the pelagic environment, pass though the purse seine web. Also, as small fish, they run a greater risk of being missed in the net clearing process than do larger fish.

A comparison of whitespotted greenling length-frequencies from large purse seine catches in Cruise 4a (12 fish) and Cruise 4b (87 fish) are provided in Figure 69. The Cruise 4a sample size is obviously quite small but may be representative since a continuous growth pattern is apparent between the two 1985 cruises. All these individuals are assumed to be in a single growing year-class (range 52 to 76 mm).

Capelin

Capelin, _Mallotus villosus_, were the fourth ranked pelagic fish although they ranked only ninth in overall catches (0.4 percent, Table lb). With the exception of three fish taken in the small seine, all 109 capelin were taken with the large purse seine. All the Cruise 4a capelin came on Transect 2 (4 sets), Stations 2 and 3, where mean abundances





Length-Frequency of Whitespotted Greenling in Purse Seines, 1985
(all transects and stations combined)

Dames & **Moore**

Figure **69**

were 1 and 40.8 fish per set (Appendix G). This latter catch in two sets on Station 3 comprised nearly all the capelin taken in 1985, since no capelin were taken in Cruise 4b. Capelin, like rainbow smelt, appear to prosper in the Port Heiden area.

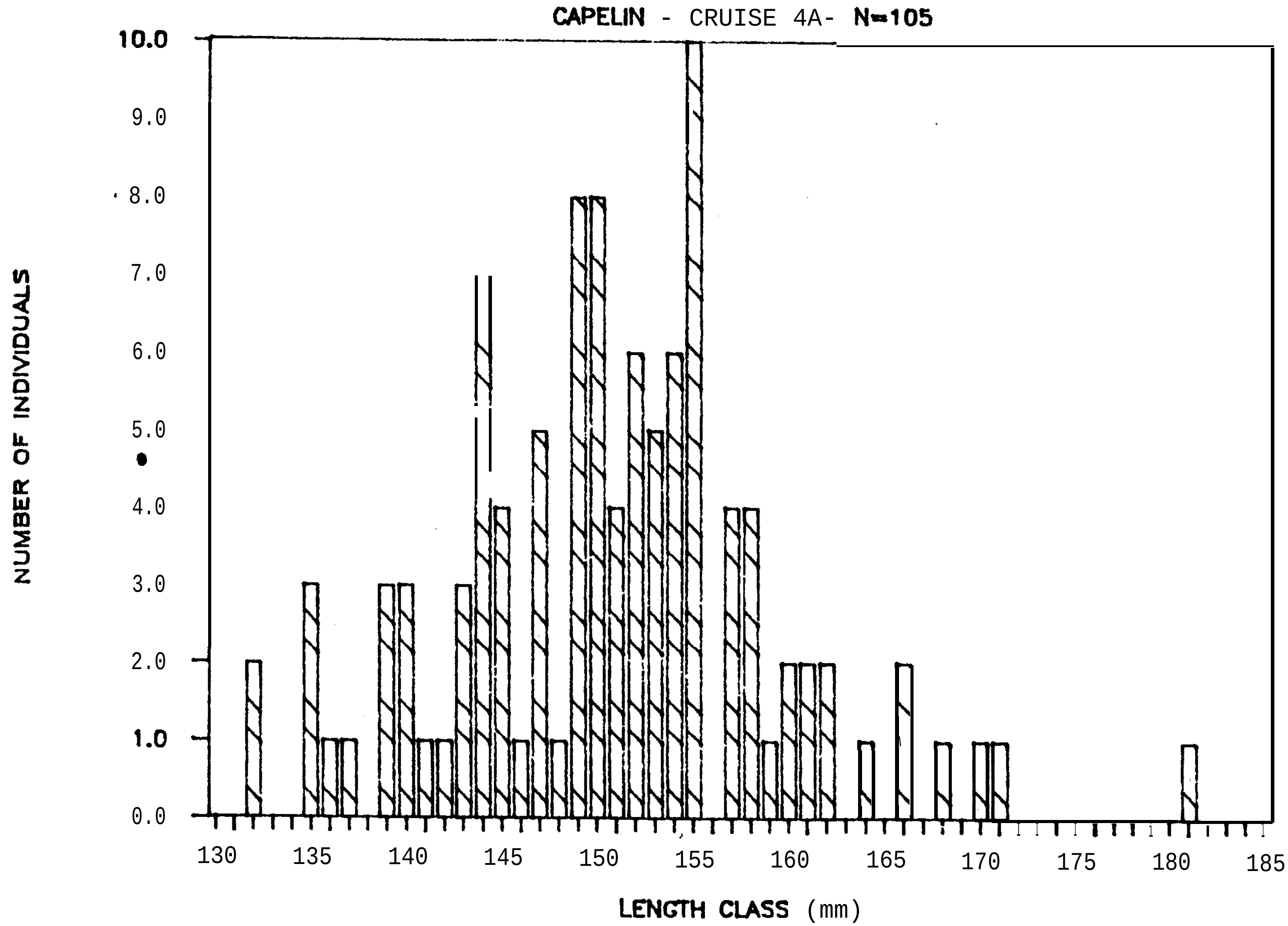
Length-frequency of 105 capelin taken by large purse seine on Transect 2 in Cruise 4a (Figure 70) appears to be a unimodal curve of a single year-class. Capelin are reported to live to be 3 or more years old (Hart 1973).

Pond Smelt

Pond smelt were the fifth ranked pelagic fish, although they ranked only tenth in overall catches (0.3 percent, Table lb). All the pond smelt were taken in the beach seine indicating strong preference for onshore and estuarine habitats. In Cruise 4a, only a single pond smelt was taken with the beach seine at Transect 4, Station 8 (Shingle Point) in the back part of Herendeen Bay.

All the remaining pond smelt were taken in Cruise 4b (July 8 to July 28) beach seines, and some individuals were taken on every transect except Transect 6 (Appendix I). At Transect O (Ugashik), Stations 4, 5, and 7, the mean abundance was 24.5, 14, and O pond smelt per set, respectively (7 sets, total). On Transect 2 (Port Heiden), Stations 5 and 6 each had a mean abundance of 1 pond smelt (6 sets, total). Transect 4 (Port Moller) (14 sets, total) had one pond smelt each at Stations 5 and 9; no smelt were taken at Stations 6 and 8.

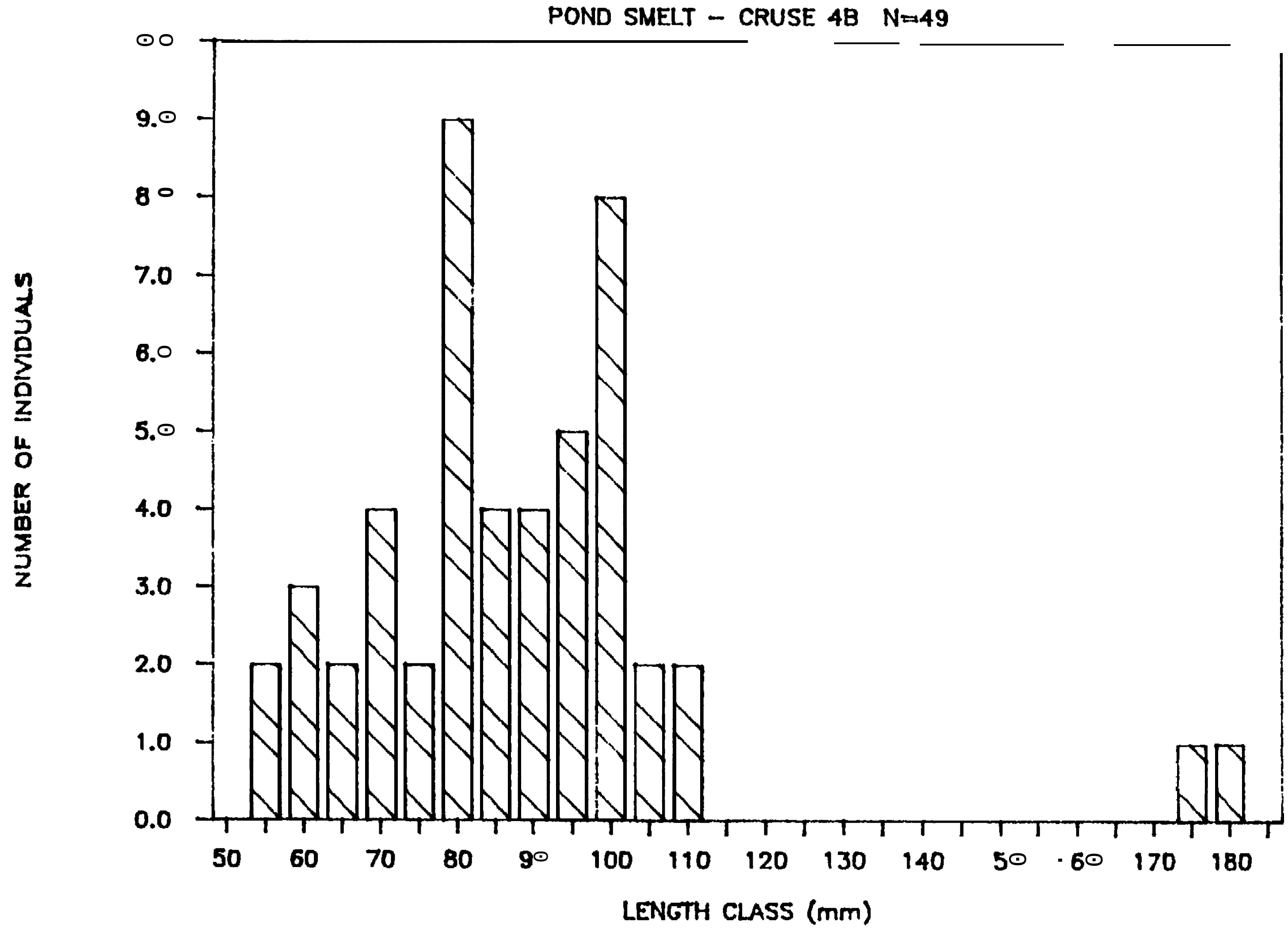
Figure 71 presents the length-frequency of 49 pond smelt from Cruise 4b beach seines. TWO year-classes are likely present in these limited data with only two individuals of the larger year-class present.



Length-Frequency of Capelin in Purse Seines, 1985
(transact 2 only)

Figure 70

Dames & Moore



Length-Frequency of Pond Smelt in Beach Seines, 1985
(all transects and stations combined)

Figure 71

Dames & Moore

Pacific Herring

Pacific herring, **Clupea harengus pallasi,** did not rank in the top ten fish captured in 1985 even though the three gear types should have taken them if they had been present in any numbers.

The few herring taken were fairly evenly distributed in small seine, large purse seine, and beach seine catches (Table lb). The beach seine took one herring in Cruise 4a at Transect 4 on Station 5 and in Cruise 4b, one herring was taken at Transect 2 at Station 5. The largest catch of herring in Cruise 4b was on Transect 4 (Port Moller) at Station 6, where 11 fish were taken in one of 5 beach seine sets on the protected side of Harbor Point (Appendix I).

In Cruise 4a, no herring were taken with the small seine. However, of the 15 fish taken in Cruise 4b (Appendix H), Transect O had a single fish at both Stations 8 and 9, and the largest catch was on Transect 4 (Port Moller) at Station 7 located behind Harbor Point. No herring were taken with the small seine on Transects 2 or 6.

In Cruise 4a, no herring were taken with the large purse seine. However, of the 27 herring taken in Cruise 4b, about half were taken in one of 10 large purse seine sets on Transect O, Station 2, 5 nm offshore (Appendix G). The remainder of the herring taken in Cruise 4b were on Transect 2, Station 3,located less than 5 nm offshore. No herring were taken on Transects 4 or 6 in Cruise 4b. Cruises 4a and 4b in 1985 must have again, as in 1984, been too late to capture larger numbers of adult herring known to be present in the study area earlier in the spring.

Dolly Varden

Dolly Varden were not ranked in the top ten fish taken in 1985 but are of interest because of how and where they were taken. Of the 49 adults and juveniles (categories based solely on size and not on sexual maturity) taken, only two came out of the beach seine (Table lb). These two fish came in Cruise 4b from Transect 4, Station 6 and Transect 6, Station 6 (Appendix I). No Dolly Varden were taken in the small seine in 1985.

Nearly all the Dolly Varden were taken offshore in the large purse seine (Appendix G) in Cruise 4a. In Cruise 4a at Transect O (Ugashik), Stations O, 1, and 2 had mean abundances of 1, 13 and 2.6 Dolly Varden (sizes combined) in 9 sets. At Transect 2 (Port Heiden), Stations O to 3 were fished (6 sets) and only a single Dolly Varden was taken at Station 2. In 16 sets at Transect 4 (Port Moller) at Stations O, 1, 2, and 3 the mean abundances were 1, 1, 5, and 4.8 fish (sizes combined). In Cruise 4a at Transect 6 (Izembek Lagoon), 8 large purse seine sets yielded 2 fish at Station O, and 1 fish at Station 2.

In Cruise 4b, the large seine captured only a single Dolly Varden on Transect 4, Station 2. No Dolly Varden were taken in this cruise at Transects O, 2, and 6.

Dolly Varden appeared to be scattered in the offshore waters of the study area in Cruise 4a, and moved out of the study area in Cruise 4b. If they had moved closer to shore in Cruise 4b, we should have seen more of them in small seine and beach seine catches.

4.6.3 Demersal Fish Species - 1985

As a result of the change in study direction to focus on pelagic species (specifically, juvenile salmon) in 1985, only incidental catches of demersal species were taken in the beach seine, small seine, and large purse seine. Section 4.6.2 on pelagic species covered the whitespotted greenling whose juvenile stage lives in the pelagic habitats of the study area. Therefore, this species will not be repeated here even though three of these greenling were taken by beach seines in a more demersal habitat.

Starry Flounder

Starry flounder was the most abundant demersal species taken in 1985, but ranked only sixth (2 percent) in total 1985 catches of the total fish caught by number (Table lb). They appeared above all other demersal species since they frequent beach areas and are vulnerable to a beach seine. The large purse seine captured only 6 of the 616 starry flounder taken; the small seine captured none (Table lb).

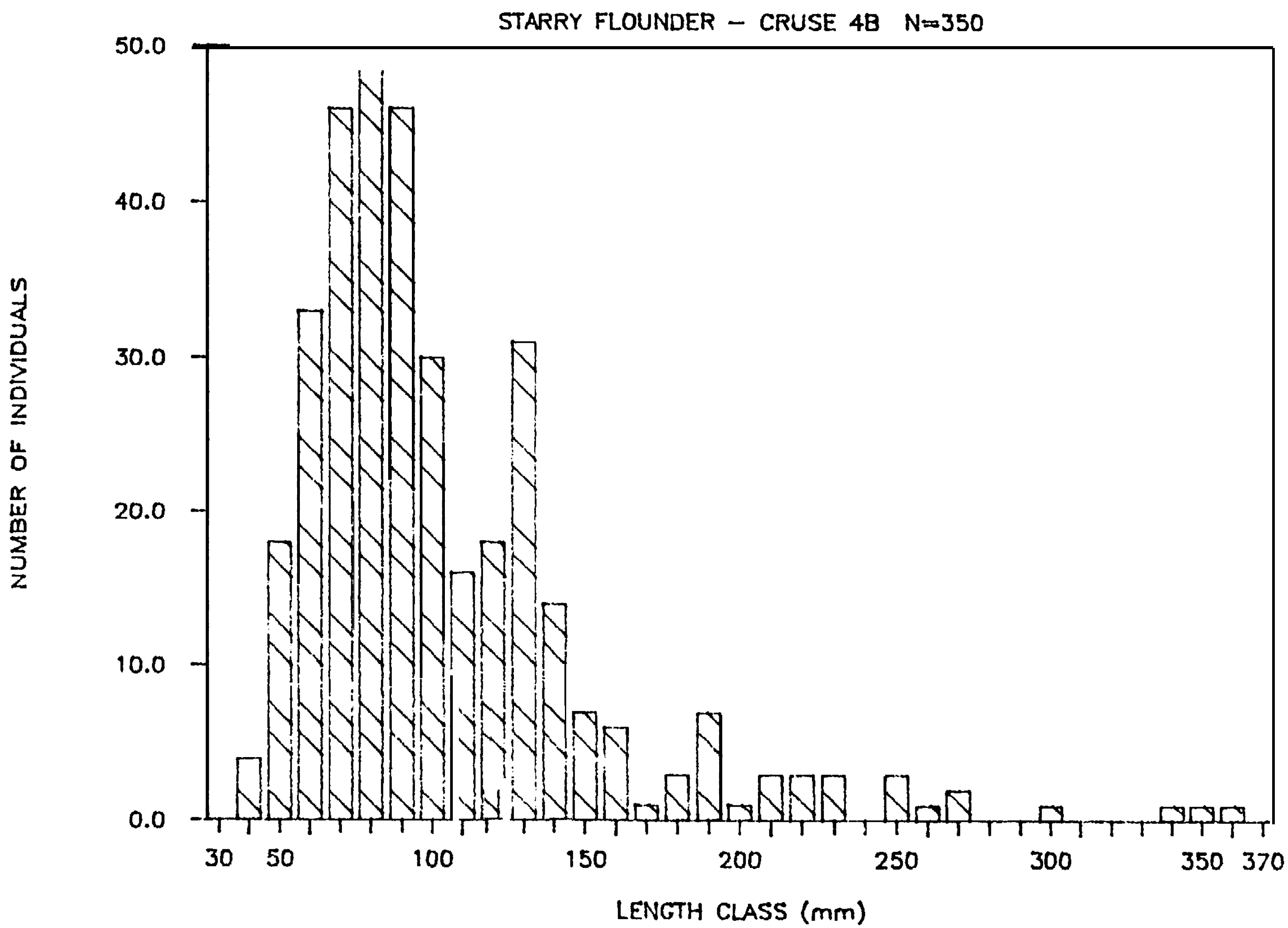
In Cruise 4a (June 16 to July 7) the only beach seining was completed on Transect 4 (10 sets), and only one starry flounder was taken in one of five sets at Station 6 on the protected side of Harbor Point (Appendix I).

In Cruise 4b (July 8 to July 28) starry flounder were unevenly distributed on beaches at all transects. The largest overall numbers of this species were taken at Transect O (Ugashik). At Stations 4, 5, and 7, the mean abundances were 25.5, 100.3, and 46 starry flounder (7 sets, total). The Smoky Point beach site seemed by far the preferred location for these fish. On Transect 2 (Port Heiden) Stations 5 and 6 had mean abundances of 26 and 26.3 fish (six sets, total). Transect 4 (Port Moller), Stations 6 and 9, each had a single starry flounder. Transect 6 (Izembek Lagoon), Stations 6 and 7, each had several fish in Cruise 4b. The larger concentrations of starry flounder near beaches in Ugashik and Port Heiden may be due to greater influences of the large rivers entering these estuaries, cf., the more marine beach areas sampled in Port Moller and Moffet Lagoon.

The length-frequencies of 350 starry flounder taken by beach seines in Cruise 4b are shown in Figure 72. The pattern of lengths in Cruise 4b is consistent with the near-beach location of capture. The majority of the fish are small 40- to 90-mm individuals; however, multiple larger year-classes are present.

Arctic Flounder

Arctic flounder ranked eleventh by number of all fish taken in 1985 (Table lb). All Arctic flounder were taken by beach seines in Cruise 4b in 1985 (Appendix I). In Cruise 4b on Transect O, a single fish was taken at Station 5 (Smoky Point in Ugashik Bay). The largest Arctic flounder catches were on Transect 2 at Port Heiden. Stations 5 and 6 had mean abundances of 3.5 and 42.5 Arctic flounder (six sets, total). On Transect 4 (Port Moller), a single fish was taken on Station 6 and on Transect 6 (Moffet Lagoon) no arctic flounder were taken. Arctic flounder were more numerous in lower salinity areas (Port Heiden) with shallow-sloped mud and fine-sand bottoms.



Length-Frequency of Starry Flounder in Beach Seines, 1980
(all transects and stations combined)

Figure 72

Dames & Moore

Other Flatfish

The remaining flatfish taken in 1985 ranked by the numbers taken were as follows: Alaska plaice (52 fish all in beach seines), yellowfin sole (27 fish in beach seines and large purse seines), and rock sole (13 fish all in beach seines).

4.7 COMPARISONS OF 1984 AND 1985 NON-SALMONID CATCH DATA

4.7.1 General

Results of our 1984 and 1985 sampling appear to confirm the seasonal importance of inshore waters and embayments along the north side of the Alaska Peninsula to a variety of nonsalmonid fish. In terms of overall ecological (and economic) importance, the role of these waters in production of forage fish is of primary significance. Two species that are already well documented in Bristol Bay, Pacific herring and capelin, were not well represented in our catches in either years, probably because the start of our sampling missed their spring onshore spawning movements. The late summer recruitment of smaller herring to our 1984 tow net catches in Port Moller may indicate a prolonged local rearing of herring spawned in this area. The virtual absence of capelin in our 1984 catches and low numbers in 1985 may indicate a lesser significance of the study area for this species than has been previously suspected (e.g., Barton et al. 1977), or may have resulted from offshore movement following their spring spawning. Both capelin and herring were reportedly abundant in midwater trawls off Izembek Lagoon by LGL Ecological Services in their separately funded ecosystem study (D. Thomson, personal communication 1986).

Several complications exist in making comparisons of 1984 and 1985 for nonsalmonid data. The lack of concurrent sampling dates between the two years is a major inconsistency. Basically, the 1985 season began 10 days earlier (June 16) than Cruise 1 in 1984 and ended July 28, two days after Cruise 2 began in 1984. Taking into account the break between Cruises 1 and 2 in 1984, Cruise 4a in 1985 had 11 days of overlap (June 26 through July 6) and Cruise 4b had only 3 days of overlap (July 25 through July 27). Even this overlap in time is relevant only for the large purse seine. In 1985, both the small purse seine and the beach seine effort in Cruise 4a were initiated after the large purse seine operation was well underway. Therefore the overlap in calendar time is less for these two gear types due to their later start dates in Cruise 4a in 1985.

The water temperature differences between similar periods in the study area in 1984 and 1985 are likely much more important than any differences in calendar date. In effect, the colder and earlier sampling dates in 1985 were really further ahead of 1984, biologically, than the calendar would indicate. With water temperatures influencing fish presence and movements in the area, the fact that water temperatures in Cruises 4a and 4b in 1985 did not approach those at similar stations in similar times in 1984 (Figure 49) is very important. In terms of water temperatures, we actually sampled two different times of the year with little or no overlap. In comparisons of catch and apparent distributions of fish, it is not surprising that 1984 and 1985 look as different as they do.

The 1984 and 1985 biological comparisons are also limited to the species taken in sufficient numbers in both years. Real comparisons can only be made with the catches from the large purse seine and the beach seine which were common to both years. The nearshore pelagic sampling comparisons are complicated by the use of a tow net in 1984 and the switch to a small purse seine in 1985 to improve our efficiency on juvenile salmonids. No good comparisons are possible, especially for the faster swimming pelagic fish which we suspect could generally outswim the tow net in 1984.

Many more fish were taken overall in 1984 than in 1985 (88,436 versus 29,986), although a considerable proportion of the 1984 catch was made up of a single very large Pacific sand lance catch (by beach seine). Even though the 1984 season had more days of field sampling, the effort (total number of sets) in both years was comparable and, in fact, the effort was higher for the large purse seine.

For the large purse seine, 71 sets in 1984 yielded 7,276 fish, while 97 sets in 1985 yielded 10,988 fish. This is quite close in terms of fish per set. The top five fish species caught (by numbers taken) in large purse seines in each year were:

	1984	1985
1.	Pacific cod juveniles	Sockeye salmon juveniles
2.	Pacific sand lance	Pacific sand lance
3.	Whitespotted greenling	Chum salmon juveniles
4.	Walleye pollock juveniles	Sockeye salmon adults
5.	Pacific sandfish	Coho salmon juveniles

It is quite apparent from these lists that large purse seine catches differed markedly from year to year.

The beach seine catches also had large numerical differences between 1984 and 1985. The 47 sets in 1984 yielded 35,122 fish while the 41 sets in 1985 yielded only 16,266 fish. This is not a great difference if one excludes the occasional extremely large catch of sand lance in 1984. Visual observations and small purse seine results indicate that the large schools of sand lance seen and sampled in 1984 were not present in 1985. The top five fish species (by numbers taken) in beach seine catches in each year were:

	1984	1985
1.	Pacific sand lance	Pacific sand lance
2.	Rainbow smelt	Chum salmon juveniles
3.	Surf smelt	Rainbow smelt
4.	Pacific staghorn sculpin	Pink salmon juveniles
5.	Starry flounder	Starry flounder

Sand lance made up 94 percent of all fish taken (by number) by beach seine in 1984 and only 51 percent of all beach seine fish in 1985. Again, it is very apparent that beach seine catches differed substantially between 1984 and 1985.

The obvious differences in catches in these two gear types common to both years strongly support the contention that the earlier start by calendar date and the colder water experienced in 1985 had profound influences on fish numbers and species present relative to 1984.

4.7.2 Pelagic Species Comparisons

Pelagic species dominated 1984 and 1985 fish catches in this study, but in different ways. In both years, Pacific sand lance ranked first in numbers caught. Howevertin 1984, yellowfin sole and other demersal species (i.e., Pacific cod, rock sole, Alaska plaice, and snake prickleback) ranked in the top 10 fish based upon numbers taken. In 1985, only the demersal starry flounder ranked in the top 10 along with 9 pelagic species (or pelagic life stages of demersal species). Juvenile salmon (discussed in detail in Sections 4.2 and 4.3) numbered 898 fish in 1984 and 15,621 fish in 1985. These pelagic salmon plus the pelagic sand lance and rainbow smelt totaled 93 percent by number of all fish taken in 1985. The 1985 shift toward a pelagic catch was primarily due to dropping the otter trawls in 1985. However, as noted above, there were also real differences in the two common gear types.

In making 1984 versus 1985 comparisons, there is a real possibility that for a given species smaller-sized fish may have been more prevalent in 1985 because of the earlier start and cooler water temperatures; thus more fish may have passed through the common-sized webs in beach and purse seines in 1985. For example, equal numbers or even more sand lance may have been present, but generally smaller in size in 1985, versus 1984. This was a real problem observed in large purse seine operations in 1984 when both small sand lance and small juveniles of Pacific cod and walleye pollock were observed passing through the web. Comparisons between 1984 and 1985 distributions and sizes of selected fish species are described below with the primary focus on Cruise 1 in 1984 and Cruises 4a and 4b in 1985.

Pacific Sand Lance

Based upon beach seine catches, Pacific sand lance were present near the beaches of the study area in greatly reduced numbers in 1985 as compared to 1984. Specifically, Port Moller (Transect 4), Stations 6, 8, and 9 in 1984 averaged several hundred to 20,000 plus (one station) more sand lance per set in Cruise 1 (late June to mid-July 1984) than in 1985. Cruise 2 (late July to mid-August) catches dropped off in 1984 indicating that the peak abundances of sand lance near beaches in the Port Moller area (where nearly all the comparable data is from) were around the time (or prevailing water temperatures) of Cruise 1 in 1984 and were of short duration. We have inadequate information to interpret whether this period of high abundance is typical or atypical of sand lance abundance in this area. Beach seine efforts in both 1984 and 1985 indicate Pacific sand lance are not very numerous in the Ugashik and Port Heiden areas. In fact, Transect 3 (Cape Seniavin vicinity) was the nearest beach seine site up-bay of Port Moller to have sand lance in 1984. On Transect 6 (Moffet Lagoon), sand lance were taken at more stations in Cruise 1 in 1984 than in 1985, but the average abundance at Station 7 (comparable to Station 10 in 1984) was higher in 1985 (average abundance 2102 versus 66.3). In 1984, some 60 percent of all sand lance (by number) came from beach seines while 74 percent of all sand lance came from this gear type in 1985.

In nearshore areas (inside the 10-m isobath), sand lance comparisons are between two gear types. Cruise 1 and 2 sampling in 1984 (late June through mid-August took sand lance nearshore northeast as far as the Cinder River vicinity (Transect 1) with tow nets, suggesting these fish may have been near or on nearby beaches exposed to the open ocean and usually impossible to successfully beach seine. Average tow net catches of sand lance in Cruise 1 in 1984 seem to reflect densities comparable to those of Cruises 4a and 4b (1985) with the small seine in the Port Moller area. However, average catch is somewhat misleading in that one small seine haul in Cruise 4b (July 23) accounted for 322 of the 336 sand lance taken with this gear in 1985. Nearshore (tow net) sand lance did not increase until Cruise 2 (late July) in 1984 with catches many times greater than in both Cruise 1 in the same year and in both cruises in 1985. In all cruises of 1984, about 36 percent of the total sand lance catch came from tow nets,while the small seine operation of 1985 caught only 3.5 percent of the total number of sand lance taken.

In offshore areas (outside the 10-m isobath), sand lance were taken in smaller numbers with the large purse seines in both years compared to beach seines and nearshore gear. Cruise 1 (late June to mid-July) in

1984 and Cruise 4a and 4b in 1985 (June 16 to July 29) produced comparable, scattered catches of sand lance at Port Heiden (Transect 2). At Port Moller (Transect 4), the 1984 catches in Cruises 1 and 2 were smaller than those of Cruise 4a and 4b in 1985. An increasing abundance of sand lance from Station O (24 km or 15 nm offshore) to Station 3 (< 8 km or 5 nm offshore) was very apparent in Cruise 4a (June 16 to July 7), and somewhat apparent in Cruise 4b (July 8 to July 29) in 1985 and in Cruises 2 and 3 (late July through mid-September) in 1984. At Izembek Lagoon (Transect 6), Cruise 4b in 1985 and Cruises 2 and 3 in 1984 also had increasing abundances of sand lance from Stations O to Station 3.

This limited sampling in 1984 and 1985 indicates two very different sampling seasons relative to pacific sand lance; numbers in 1984 were considerably greater overall than those in 1985, especially nearshore and on the beaches. Both years' efforts indicate that sand lance numbers drop as one moves up-bay past Cape Seniavin. The data suggest that this species is present in the pelagic environment only in small numbers offshore and increases dramatically closer to shore.

Length-frequency comparisons between 1984 and 1985 do not present an expected pattern. The peaks of the length-frequency distribution of sand lance from beach seines in Cruise 1 and 2 (1984) were at 70 and 80 mm, respectively (Figure 52). In 1985, the Cruise 4a and 4b modes were at 90 and 95 mm (Figure 63). In both years, growth is apparent between cruises. One might expect the beach seine-caught fish in 1985 to be smaller than those in 1984 due to colder water temperatures in 1985; however, the opposite pattern exists. A possible explanation is the cycling of larger and then smaller sand lance as seen in the three 1984 cruises (Figure 52). If varying sized sand lance move sequentially through beaches in the study area, there may be a somewhat random opportunity in sampling them at a given time to get fish of a particular size. The problems of quantitative sampling of this needle-shaped fish species whose smaller life stages can easily pass through the web of any gear type used in 1984 and 1985 must be noted.

Rainbow Smelt

Rainbow smelt were more numerous in beach seine hauls in Port Moller (Transect 4) early in 1985 than in Cruise 1 in 1984 (Transect 4 was the only transect beach seined in Cruise 4a). At Station 5, average abundance was roughly three times as great (11 versus 35.7 fish per set) in 1985. More rainbow smelt also were taken at Stations 5 and 6 in Port Moller in 1984 in Cruise 2 than during Cruise 4b in 1985. The opposite pattern was shown for Moffet Lagoon (Transect 6) where no rainbow smelt were taken in Cruise 4b (1985) and average abundances of up to 20 smelt per set were taken in Cruise 2 (1984). At Ugashik (Transect O) numbers of rainbow smelt taken in Cruise 4b were comparable with catches in Cruise 2 in 1984. The sample sizes, both in number of sets that can actually be compared between years and the variability within sets in a given year at the same station, suggest that this species is very patchy in its occurrence.

Nearshore area comparisons require the evaluation of catches in two different gear types. Tow nets in Cruise 1 in 1984 captured no rainbow smelt in Port Moller. Small seine sets in Cruise 4a in 1985 captured small numbers of smelt, and larger numbers were taken in Cruise 4b. In contrast, at Ugashik (Transect O) tow nets in Cruise 2 in 1984 averaged about 3500 smelt per tow against the 100 to 200 fish per small seine set in 1985. These catch rates are not equally representative of the smelt present at Ugashik, even though the 1984 tow net sets were made at about the same location (Station 8) as the small seine was fished in 1985. The tow net was held open to the river flow in 1984 while the small seine sampled the opposite direction due to tides in 1985.

Length-frequencies of rainbow smelt were compared from beach seines in 1984 and 1985. The Cruise 4a and 4b peaks in 1985 were at 90 and 95 mm while the Cruise 1 and Cruise 2 peak modes in 1984 were at 120 and 90 mm, respectively. There appears to be some reduction in size in 1985, possibly due to colder water temperatures, but as with sand lance, multiple size classes of these smelt may be present at various times near beaches in the study area.

Whitespotted Greenling

Whitespotted greenling were taken in greater numbers in the large purse seine in 1984 than 1985. Those greenling taken in 1984 in Cruise 1 generally ranged from about 55 to 85 mm. As can be seen in Figure 69 the 1985 greenling, taken in colder water and generally earlier in the year, were smaller than fish taken in 1984. As might be expected, 1984 otter trawl caught fish (Figure 63) were larger than greenling from the 1985 large purse seine (Figure 69). This is the result of movement from the pelagic to the demersal habitat as size increases.

Greater numbers of greenling may have been present in 1985 than are reflected in the catches, but their smaller size likely allowed many to pass through the large purse seine's web.

Capelin

Capelin were taken primarily in the large purse seine in 1985 (106 fish), whereas no capelin were taken in this gear in 1984. The single capelin taken in 1984 was in a beach seine. Assuming that the large purse seine is an adequate gear for this species, one must conclude that sampling began too late in 1984 to capture capelin. Capelin still were not very numerous in 1985 suggesting that we may have missed the majority of capelin in the study area where they reportedly occur in larger numbers earlier in the spring (Barton et al. 1977).

Pacific Herring

Pacific herring were taken in small numbers in all three gear types fished in 1985 (total catch 55 fish). In 1984, all but 8 of the herring taken were from the tow net (742 fish) which was not fished in 1985. Since the two gear types fished in the nearshore area were different, it is not possible to say herring were less numerous in 1985 than in 1984. There is a possibility that the small purse seine fished in 1985 was not as effective on small herring as the tow net used nearshore in 1984. Where other gear can be compared, the large purse seine took 27 fish in 1985 versus 4 in 1984 and the beach seine took 13 fish in 1985 versus 3 in 1984. With this mixed pattern it is not possible to conclude how the earlier sampling season and colder water temperatures affected herring catches in 1985. It is likely that in neither year were we sampling early enough to assess periods of peak herring abundances in the study area.

Dolly Varden

Dolly Varden were caught offshore in large purse seines in much smaller numbers in 1984 (2 fish) than in 1985 (47 fish). In addition, the smaller Dolly Varden seen and called juveniles in 1985 (Table lb) were not seen in 1984. Again, the earlier season and colder waters of 1985 may explain these offshore differences with the same gear compared in the 2 years. The smaller fish may also be responding to the same food stimuli that are attracting juvenile salmon to the study area.

Pond Smelt

Pond smelt were taken in greater numbers (96 fish) in 1985 beach seines than in 1984 (27 fish). No other gear types captured pond smelt in either year, supporting the anticipated pattern of a close association with beach habitats.

4.7.3 Demersal Species Comparisons

As previously stated, the demersal species catch in 1985 dropped substantially due to the otter trawl effort being discontinued. Based on numbers caught, demersal fish ranked second (yellowfin sole), fourth (Pacific cod), sixth (rock sole), ninth (Alaska plaice) and tenth (snake prickleback) in total numbers of fish taken in 1984. In addition, whitespotted greenling ranked fifth in 1984, but over 62 percent of those caught were in the large purse in a pelagic life stage. Similarly, walleye pollock ranked eighth in 1984 but almost 95 percent of the fish taken were by large purse seine in the pelagic habitat. Even Pacific cod, fourth-ranked in 1984, had over 44 percent of its numbers taken by the large purse seine in the pelagic habitat. Clearly, this man-made division of fish into pelagic and demersal categories is complicated by life stages of fish moving from one place to another.

In 1985, the starry flounder ranked sixth in total numbers caught (Table lb) with nearly all of those taken by beach seine. Thus, extensive comparison of 1984 and 1985 demersal fish data is difficult.

Starry Flounder

Based upon total numbers taken by beach seine, starry flounder were generally more numerous in 1985 (610 fish) than in 1984 (106 fish). This suggests that starry flounder may diminish in numbers near the beaches in the study area as the season progresses and water temperatures increase. Smaller-sized starry flounder dominated beach seine catches, thus year-class strength, timing of onshore/offshore movements, or predation rates could contribute to these annual differences. Length-frequency modes in the 65- to 90-mm range seen in 1984 were also seen in the 1985 catches of starry flounder.

Pacific Cod

Demersal Pacific cod can only be compared between beach seines where numbers of this species were small in each year (13 in 1985 versus 83 in 1984). For the pelagic life stage taken in the large purse seine, some dramatic differences existed between the two years. In 1984, the large purse seine captured 3007 pelagic cod while in 1985 only 10 were taken. As with pelagic whitespotted greenling in the large seine, reduced numbers in the large purse seine may have been due to the colder water temperatures and the earlier season sampled in 1985 compared to 1984. Again, there is the possibility that greater numbers of Pacific cod were present in the area but their smaller size caused by colder water temperatures and/or an earlier sampling season may have allowed many more of them to pass through the seine's web in 1985. Variation in year-class strength of Pacific cod recruited into the study area could also contribute to the great difference between 1984 and 1985 pelagic catches.

Walleye Pollock

A difference in pelagic walleye pollock numbers was very apparent between the two years sampled. In 1984, the large purse seine captured 557 fish compared to 15 fish taken in 1985 within this gear type. The above discussion for Pacific cod applies also to these patterns of pelagic walleye pollock abundance.

5.0 REFERENCES

American Fisheries Society (AFS). 1980. A list of common and scientific names of fishes from the United States and Canada. AFS special publ. no. 12, Fourth edition. Bethesda, MD. 174 pp.

Andrievskaya, L.D. 1970. Feeding of Pacific salmon juveniles in the Sea of Okhotsk. Fisheries Research Board of Canada Translation Series No. 2441.

Bakkala, R.G. 1981. Population characteristics and ecology of yellowfin sole. In: The Eastern Bering Sea shelf: Oceanography and resources (D.W. Wood & J.A. Calder, eds.), vol. I:553-574. NOAA, distributed by Univ. of Wash. Press. Seattle, WA.

Bakkala, R., V. Wespestad and L. Low. 1982. The yellowfin sole (Limanda aspera) resource of the eastern Bering Sea - its current and future potential for commercial fisheries. Unpubl. manuscr., Northwest and Alaska Fish Ctr., NMFS, NOAA. Seattle, WA. 42 pp.

Barton, L.H. 1978. Finfish resource surveys in Norton Sound and Kotzebue Sound. Final rept. to NOAA/OCSEAP.

_ . 1979. Assessment of spawning herring and capelin stocks at selected coastal areas in the eastern Bering Sea. Annual rept. to N. Pac. Fish. Mgmt. Council, contract 78-5, ADF&G, Comm. Fish. Div. Anchorage, AK.

Barton, L.H., I.M. Warner and P. Shafford. 1977. Herring spawning surveys - southeastern Bering Sea. In: Environmental assessment of the Alaskan continental shelf. Final repts. of principal investigators. vol. VII:1-112. NOAA/OCSEAP. Boulder, CO.

Barton, L.H. and D.L. Steinhoff. 1980. Assessment of spawning herring (Clupea harengus pallasii) stocks of selected coastal areas in the eastern Bering Sea. ADF&G informational leaflet no. 187. Juneau, AK. 60 pp.

Bax, N.J., E.O. Sale, B.P. Snyder, C.A. Simenstad and W.J. Kinney. 1980. Salmon outmigration studies in Hood Canal: A summary - 1977. In: Salmonid ecosytems of the North Pacific, pp. 171-202. Oregon State Univ. Press. Corvallis, OR.

Bax, N.J. 1983. The early marine migration of juvenile chum salmon (Oncorhynchus keta) through Hood Canal--its variability and consequences. Ph.D. dissertation, Univ. of Wash., Seattle. 196 pp.

_ " 1985. Simulations of the effects of oil spill scenarios on juvenile and adult sockeye salmon (Oncorhynchus nerka) migrating through Bristol Bay, Alaska. NOAA, NMFS, NWAFC Processed Rept. 8503. 128 pp.

Baxter, R. 1976. Inshore marine resources, Bristol Bay, Alaska. Unpubl. rept. ADF&G. Bethel, AK.

Brett, J.R., M. Hollands and D.F. Alderdice. 1958. The effect of temperature on the cruising speed of young sockeye and coho salmon. J. Fish. Res. Board Can. 15(4):587-605.

Cable, M. 1981. Yellowfin sole studies in the nearshore Togiak area of Bristol Bay. Unpublished paper presented to ADF&G. Juneau, AK.

Cobb, J.N. 1916. Pacific cod fisheries. U.S. Department of Commerce, Bureau of Fisheries dot. no. 830. Appendix IV to the report of the U.S. Commission of Fisheries for 1915. Washington, DC. 111 pp.

Conrad, R.H. 1983. Management applications of scale pattern analysis for the sockeye salmon runs to Chignik, AK. MS thesis, Univ. of Wash., Seattle. 232 pp.

Cook, R.C. 1979. Stock identification of Bristol Bay sockeye salmon on the high seas by polynomial discriminant analysis of scale patterns. MS thesis, Univ. of Wash., Seattle. 94 pp.

_ " 1982. Estimating the mixing proportion of salmonids with scale pattern recognition applied to sockeye salmon (Oncorhynchus nerka) in and around the Japanese land-based driftnet fishery. Ph.D. Dissertation, Univ. of Wash., Seattle. 264 pp.

Dames & Moore. 1978. The social and economic impacts of a commercial herring fishery on the coastal villages of the Arctic/Yukon Kuskokwim area. Report to the North Pacific Fishery Management Council. Council dot. no. 3. 186 pp.

_ " 1983. Marine Biological Studies. Knik Arm Crossing, tech. memorandum no. 15, U.S. Dept. of Transportation, Federal Highway Administration and Alaska Dept. of Transportation.

Dixon, W.J. and M.B. Brown. 1983. Biomedical Computer Programs P-Series. Univ. of Calif. Press. Berkeley.

Eschmeyer, W.N., E.S. Herald and H. Hammann. 1983. A field guide to Pacific coast fishes of North America. Houghton Mifflin Co. 336 pp.

Eggers, D.M. and H.J. Yuen (eds.). 1984, 1982. Bristol Bay sockeye salmon smelt studies. ADF&G tech. data rept. no. 103. 72 pp.

Fadeev, N.S. 1970. The fishery and biological characteristics of yellowfin sole in the eastern part of the Bering Sea. Tr. Vses. Nachno-Issled. Inst. Morsk. Rybn. Knoz. Okeanogr. 70 (Izv. Tikhookean. Nauchno-Issled. Inst. Rybn. Knoz. Okeanogr. 72:327-90.

Fried, S.M. and D.C. Whitmore. 1983. Pacific herring stocks and fisheries in the eastern Bering Sea: Preliminary report for 1983. A rept. to the N. Pac. Fish. Mgmt. Council. 14 pp.

Grabacki, S. 1984. Bristol Bay underdeveloped commercial fisheries potential. Report to State of Alaska, Department of Community and Regional Affairs from Dames & Moore, Anchorage.

Groot, K. and K. Cooke. (In prep.). Migration of Fraser River juvenile sockeye salmon (Oncorhynchus nerka) in the Strait of Georgia, on their way to the ocean.

Haflinger, K.E., and C.P. McRoy. 1983. Yellowfin sole (Limanda aspera) predation on three commercial crab species (Chionoecetes opilio, C. bairdi, and Paralithodes camtschatica) in the southeast Bering Sea. Unpubl. rept. to Nat'l. Mar. Fish. Ser. 28 pp.

Hagen, P.T. 1983. Juvenile halibut nearshore in Bristol Bay: A brief report to the Halibut Commission. Unpub. MS. June 1983.

Hart, J.L. 1973. Pacific fishes of Canada. Fisheries Research Board of Canada, bull. 180. 740 pp.

Hartt, A.C. and M.B. Dell. 1978. Early oceanic migrations and growth of juvenile Pacific salmon and steelhead trout. Unpub. MS.

Hartt, A.C. 1980. Juvenile salmonids in the oceanic ecosystem - the critical first summer. In: McNeil and Hinsworth (eds.), Salmonid ecosystems of the North Pacific. Oregon State Univ. Press, Corvallis.

Hoar, W.S. and P.J. Randall (eds.). 1978. Fish physiology. Vol. III Locomotion. Academic Press. 576 pp.

Houghton, J.P., J.S. Isakson, D.E. Rogers and P.H. Poe. 1985. Fish use of inshore habitats north of the Alaska Peninsula," June - September 1984. Annual report to National Oceanic and Atmospheric Administration Ocean Assessment Division, Anchorage (R.U. 659), Contract No. 84-ABC-00122.

Hutturen, D.C. (cd.). 1982, 1981. Bristol Bay sockeye salmon smelt studies. ADF&G tech. data rept. no. 73. 63 pp.

International Pacific Halibut Commission. Unpublished data.

Johnsen, R.C. and C.W. Sims. 1973. Purse seining for juvenile salmon and trout in the Columbia River estuary. Trans. Am. Fish. Sot. 102(2):341-345.

Kinnetic Laboratories, Inc. 1984. Environmental characterization of the north Aleutian shelf nearshore region. vol. 1. Characterization, processes, and vulnerability to development. Final report (contract no. 83-ABC-00113) to NOAA, Alaskan Office of Oceanography and Marine Services, National Ocean Service. Juneau, AK.

Knutsen, C.M. 1985. Chinook salmon scale character variability due to body area sampled and possible effects on stock separation studies. MS Thesis, Univ. of Wash., Seattle. 141 pp.

Krasnowski, P.V. and M.L. Bethe. 1978. Stock separation studies of Alaskan salmon based on scale pattern analysis. Alaska Dept. Fish & Game, Info. leafl. 175. 40 pp.

Lanigan, S.H. and T. Wagner. 1985. Survey of critical aquatic habitat areas and fishery resources in the Meshik River pipeline corridor. King Salmon Fishery Resources, U.S. Fish and Wildlife Service. Unpub. MS.

LGL Ecological Associates, Inc. 1985. Environmental characterization and biological utilization of the North Aleutian Shelf nearshore zone. Annual report to National Oceanic and Atmospheric Administration, Ocean Assessment Division, Anchorage (R.U. 658).

Laroche, W.A. and R.L. Holton. 1979. Occurrence of O-age English sole, Parophrys vetulus, along the Oregon coast: An open coast nursery area? Northwest Sci. 53:94-96.

Macy, P.T., J.N. Wall, N.D. Lampsakis and J.E. Mason. 1978. Resources of non-salmonid pelagic fishes of the Gulf of Alaska and eastern Bering Sea. Pt. 1. NOAA, Nat'l. Mar. Fish. Ser. Seattle, WA. 355 pp.

McMurray, G., A.H. Vogel, P.A. Fishman, D.A. Armstrong and S.C. Jewett. 1984. Distribution of larval and juvenile red king crabs (Paralithodes camtschatica) in Bristol Bay. Final report (contract no. 83-ABC-00067) to NOAA/OCSEAP RU 639.

McRoy, C.P. and A. Peden. 1964. Fishes collected in Izembek Lagoon, Izembek National Wildlife Range, Alaska. In: Unpublished narrative report, pp. 41-43. Aleutian Islands National Wildlife Refuge and Izembek National Wildlife Range, U.S. Fish & Wildlife Serv., Bureau of Sport Fish and Wildlife. 54 pp.

Morrow, J.E. 1980. Freshwater fishes of Alaska. Northwest Publishing co. Anchorage, AK. 248 pp.

Mundy, P.R. 1979. A quantitative measure of migratory timing illustrated by application to the management of commercial salmon fisheries. Ph.D. dissertation, Univ. of Wash., Seattle. 85 pp.

_ " 1983. Lecture two: Theory and practice; shrimping in North Carolina. In: Proceedings of Sea Grant lecture "Real-time fisheries management," Univ. of Wash., Seattle, WA. 64 pp.

Musienko, L.N. 1970. Reproduction and development of Bering Sea fishes. In: Soviet fisheries investigation in the northeastern Pacific (P.A. Moiseev, cd.), pp. 161-224. Pt. V. Moscow, 1970. (In Russian. Transl. by Israel Prog. Sci. Transl.)

Novikov, N.P. 1964. Basic elements of the biology of the Pacific halibut (Hippoglossus stenolepis Schmidt) in the Bering Sea. In: Soviet fisheries investigation in the northeastern Pacific (P.A. Moiseev, cd.), vol. 2:175-219. U.S. Dept. Comm./NTIS.

Ogi, H. 1973. Ecological studies on juvenile sockeye salmon, Oncorhynchus nerka (Walbaum) in Bristol Bay with special reference to its distribution and population. Hokkaido Univ. Bull. Fat. Fish., vol. 24:14-41.

Prokhorov, V.G. 1968. Winter period of life in herring in the Bering Sea. Proc. Pac. Sci. Res. Inst. Fish. Oceanogr. 64:329-38. (Transl. 1970, Fish. Res. Bd. Can., Transl. Ser. 1433).

Rauck, G. and J.J. Zijlstra. 1978. On the nursery aspects of the Wadden Sea for some commercial fish species and possible long-term changes. Rapp. P-V. Reun. Cons. Int. Explor. Mer., vol. 172:266-275.

Rogers, D.E. 1977. Determination and description of knowledge of the distribution, abundance, and timing of salmonids in the Gulf of Alaska and Bering Sea. Final report to OCSEAP/NMFS, FRI-UW-7736. 29 pp.

Rogers, D.E., K.W. Myers, C.K. Harris, C.M. Knutsen, R.V. Walker and N.D. Davis. 1984. Origins of chinook salmon in the area of the Japanese mothership salmon fishery. Univ. of Wash., Fish. Res. Inst. final rept. FRI-UW-8408.

Schumacher, J.D. and P.D. Moen. 1983. Circulation and hydrography of Unimak Pass and the shelf waters north of the Alaska Peninsula. NOAA tech. mem. ERL PMEL-47. Pacific Marine Environmental Laboratory. Seattle, WA. 75 pp.

Simenstad, C.A., K.L. Fresh and E.O. Sale. 1982. The role of Puget Sound and Washington coastal estuaries in the life history of Pacific salmon: An unappreciated function. In: Estuarine Comparisons (V.S. Kennedy, cd.), pp. 343-364. Academic Press. 709 pp.

Smith, R.L. and A.C. Paulson. 1977. Osmoregulatory seasonality and freezing avoidance in some fishes from a subarctic eelgrass community. Copeia 2:362-369.

Smith, R.L., A.C. Paulson and J.R. Rose. 1978. Food and feeding relationships in the benthic and demersal fishes of the Gulf of Alaska and Bering Sea. In: Environmental assessment of the Alaskan continental shelf. Final repts. of principal investigators, vol. 1:33-107. NOAA/OCSEAP. Boulder, CO.

Steele, J.H. and R.C. Edwards. 1970. The ecology of O-group plaice and common dabs in Loch Ewe. Dynamics of the plaice and dab populations. J. Exp. Mar. Biol. Ecol, vol. 4:174-187.

Stern, L.J., D.E. Rogers and A.C. Hartt. 1976. Determination and description of knowledge of the distribution, abundance and timing of salmonids in the Gulf of Alaska and Bering Sea. Final repts. of principal investigators, vol. 2:691-748. OCSEAP/NOAA. Boulder, CO.

Straty, R.R. 1974. Ecology and behavior of juvenile sockeye salmon (Oncorhynchus nerka) in Bristol Bay and the eastern Bering Sea. In: Oceanography of the Bering Sea (D.W. Hood and E.J. Kelley, eds.), ch. 14:285-320. Inst. of Mar. Sci., Univ. of Alaska, Fairbanks, AK.

_ " 1975. Migratory routes of adult sockeye salmon, Oncorhynchus nerka, in the eastern Bering Sea and Bristol Bay. U.S. Department of Commerce, NOAA tech. rept. NMFS SSRF-690, 32 pp.

_ " 1981. Trans-shelf movement of Pacific salmon. In: The eastern Bering Sea shelf: Oceanography and resources (D.W. Hood and J.A. Calder, eds.), vol. I:575-595. U.S. Department of Commerce, NOAA, off. Mar. Pollut. Assess. Juneau, AK.

Straty, R.R. and Jaenike. 1980. Estuarine influence of salinity, temperature and food on the behavior growth and dynamics of Bristol Bay sockeye salmon. In: McNeil and Hinsworth (eds.), Salmonid ecosystems of the North Pacific. Oregon State Univ. Press, Corvallis.

Tack, S.L. 1970. The summer distribution and standing stock of the fishes of Izembek Lagoon, Alaska. M.S. thesis, University of Alaska. Anchorage, AK. 111 pp.

Thornburgh, K.R. 1979. Patterns of resource utilization in flatfish communities. M.S thesis, Univ. of Wash. Seattle, WA.

Thorsteinson, L.K., ed. 1984. The North Aleutian shelf environment and possible consequences of planned offshore oil and gas development. In: Proceedings of a synthesis meeting, Anchorage, March 9-11, 1982. NOAA/OCSEAP. Juneau, AK. 159 pp.

Thorsteinson, F.V. and L.K. Thorsteinson. 1984. Fishery resources. In: Thorsteinson, 1984. pp. 115-155.

Vesin, J.P., W.C. Leggett and K.W. Able. 1981. Feeding ecology of capelin (Mallotus villosus) in the estuary and western Gulf of St. Lawrence and its multispecies implications. Can. J. Fish. Aquat. Sci. 38:257-267.

VTN Oregon, Inc. 1984. (R.L. Cimberg, D.P. Costa, P.A. Fishman) Ecological characterization of shallow subtidal habitats in the North Aleutian Shelf. Final report to NOAA/OCSEAP. R.U. 623.

Wakabayashi, K. 1974. Studies on resources on the yellowfin sole in the eastern Bering Sea. I. Biological characters. Japan Fishery Agency, Far Seas Fish. Res. Lab. Shimizu, Japan. Unpubl. MS.

Waldron, K.D. 1981. Ichthyoplankton. In: The eastern Bering Sea shelf: oceanography and resources (D.W. Hood and J.A. Calder, eds.), vol. 1:471-493. NOAA, distributed by Univ. of Wash. Press. Seattle, WA.

Walters, G.E. and M.J. McPhail. 1982. An atlas of demersal fish and invertebrate community structure in the eastern Bering Sea: Part 1, 1978-81. NOAA technical memorandum NMFS F/NWC-35. 122 pp.

Walters, G.E. 1983. An atlas of demersal fish and invertebrate community structure in the eastern Bering Sea: Part 2, 1971-77. NOAA technical memorandum NMFS F/NWC-40. 152 pp.

Warner, I.M. and P. Shafford. 1977. Forage fish spawning surveys - southeastern Bering Sea. In: Environmental assessment of the Alaskan continental shelf. Final repts. of principal investigators, vol. 10:1064. NOAA/OCSEAP. Boulder, CO.

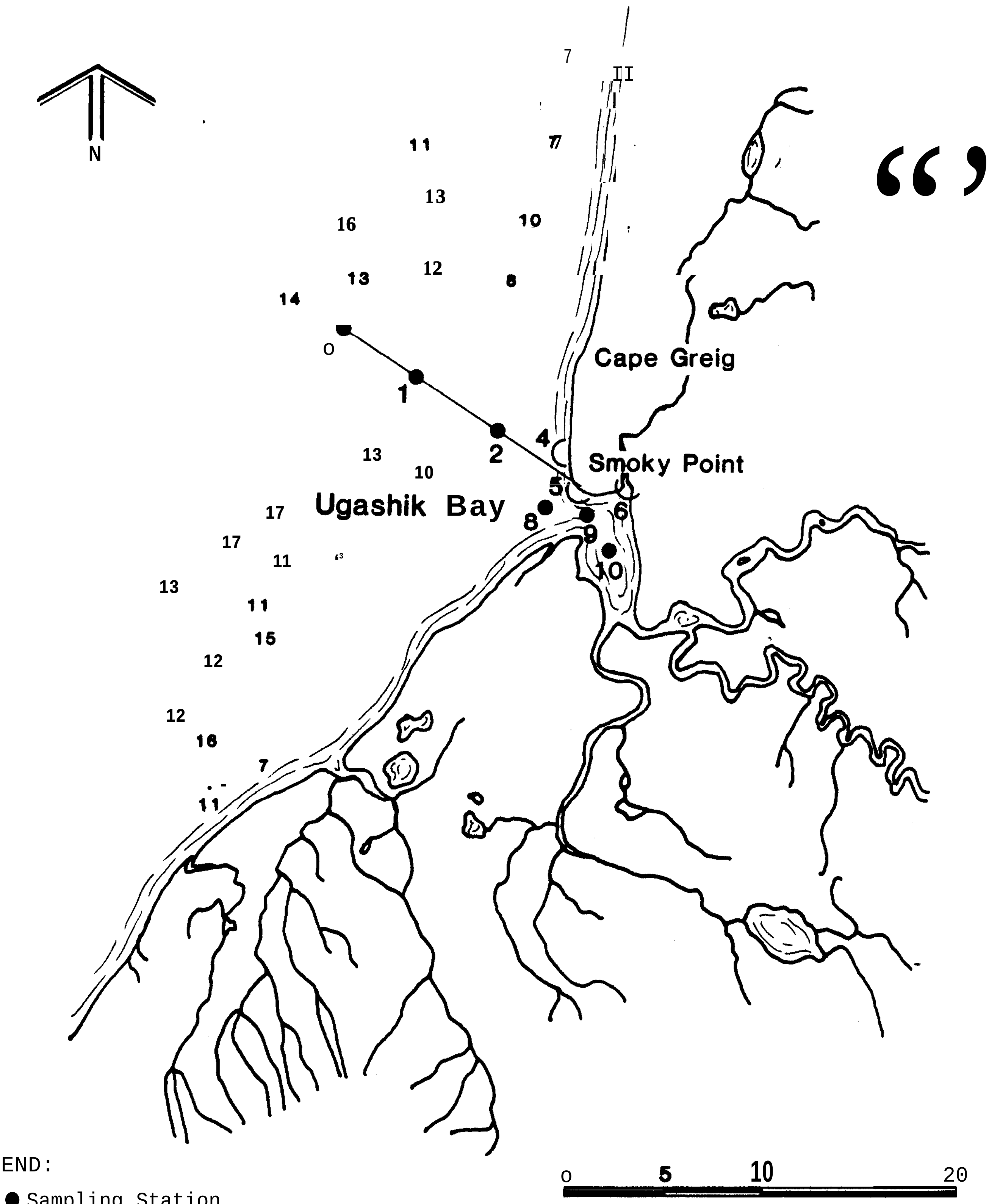
Wespestad, V.G. and L.H. Barton. 1981. Distribution migration, and status of Pacific herring. In: The Eastern Bering Sea shelf: Oceanography and resources (D.W. Hood and J.A. Calder, eds.), vol. 1:509-525. NOAA, distributed by Univ. of Wash. Press. Seattle, WA.

Wilmovsky, N.J. 1958. Provisional keys to the fishes of Alaska. Fisheries Research Laboratory, U.S. Fish and Wildlife Service, Juneau. 113 pp.

Zeh, J.E., J.P. Houghton and D.C. Lees. 1981. Evaluation of existing marine intertidal and shallow subtidal biologic data. EPA-600/7-81-036. 262 pp.

APPENDIX A

STATION LOCATION FIGURES



LEGEND:

1 ● Sampling Station

4 (Beach Seine

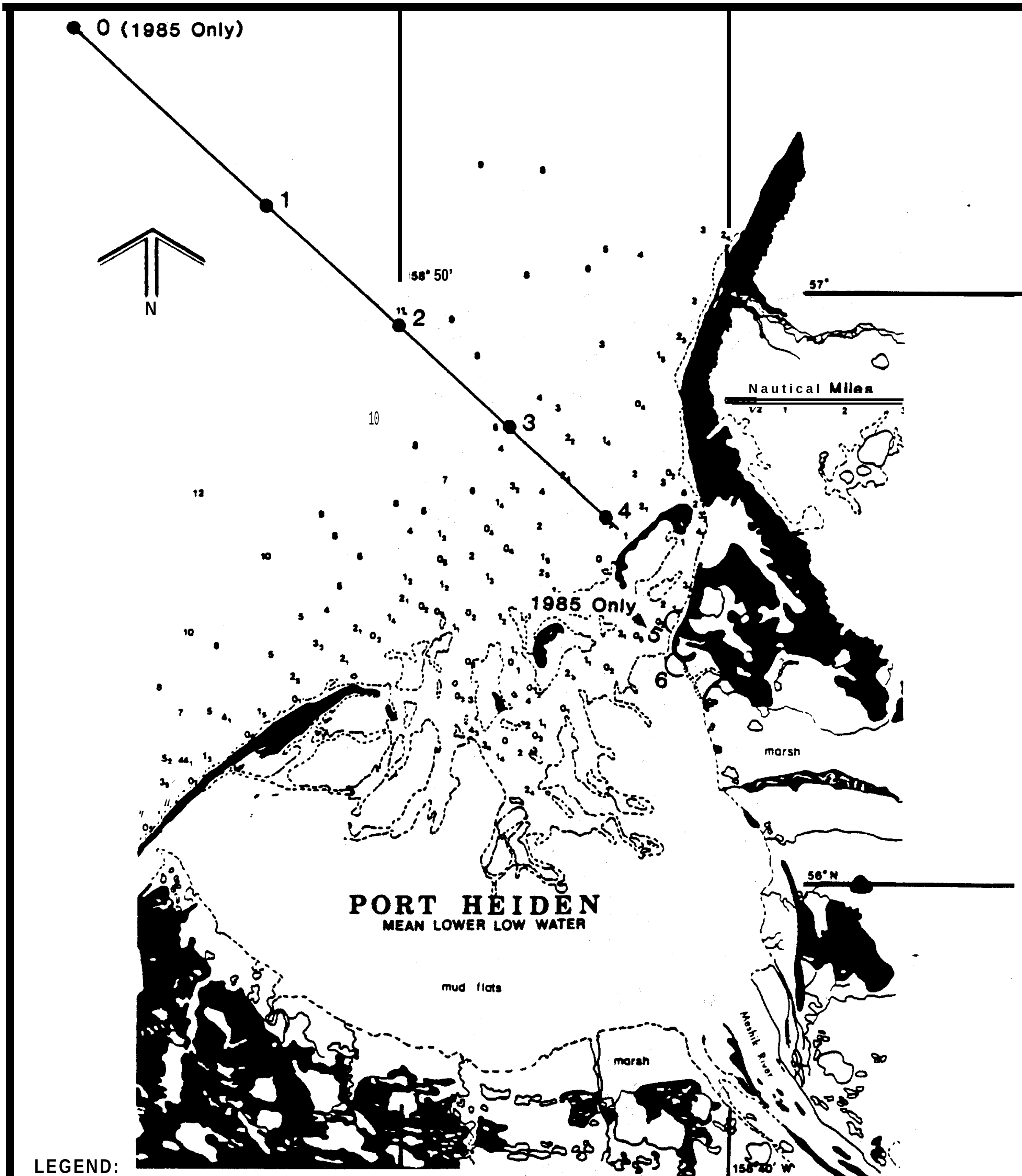
NOTES:

1. Source: NOAA Chart 16011
2. Depths Shown ● re in Fathoms
3. No Outside Stations in 1084

Approximate Station Locations
Transect O, 1984 and 1985

Dames & Moore

Figure A-1



LEGEND:

● 1 Sampling Station

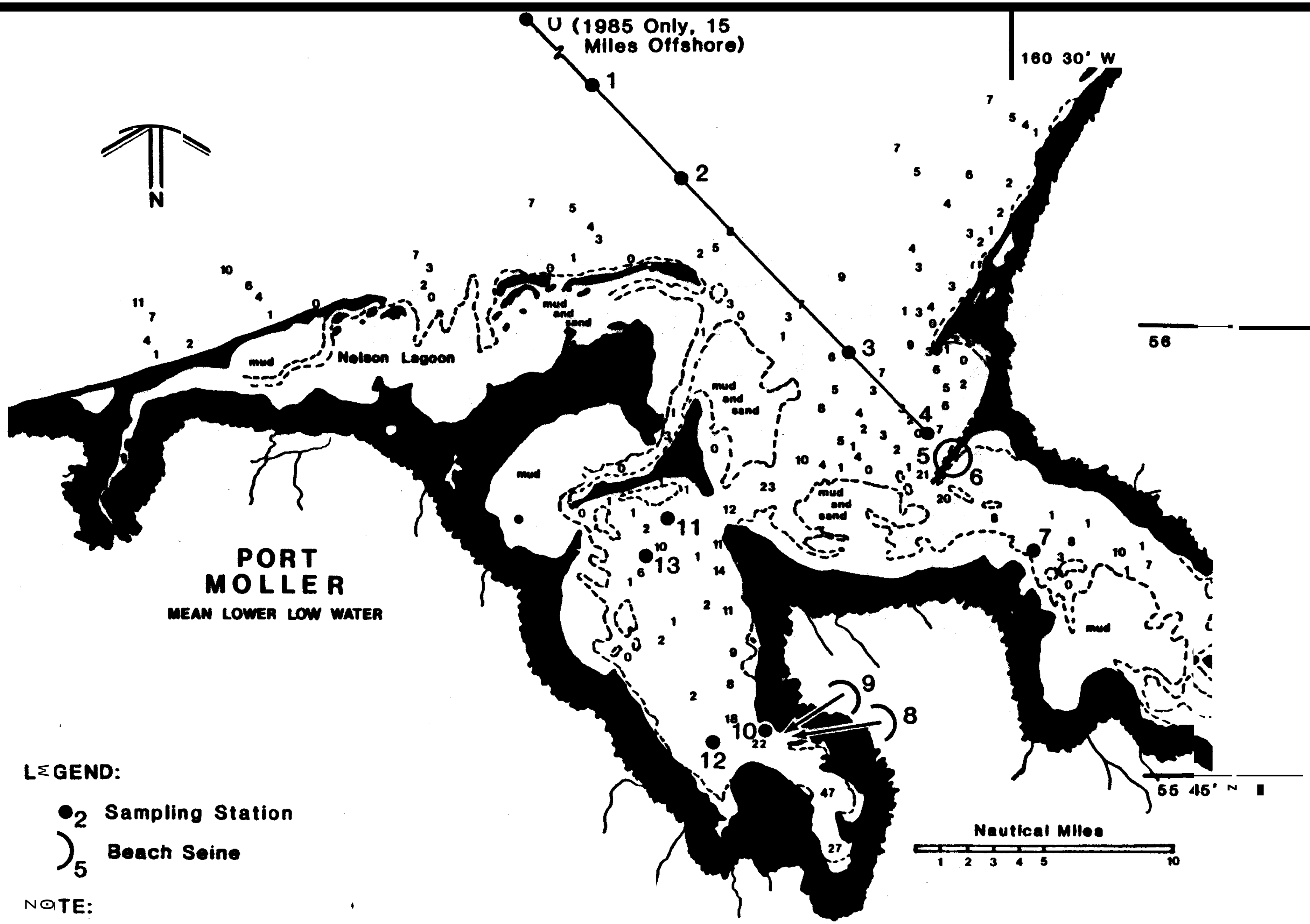
)5 Beach Seine

NOTES:

1. Bathymetry and coastline are no longer as shown on NOAA Chart 16343 (Source for this drawing)
2. Depths shown are in fathoms
3. Stations 0 and 5 – 1985 only.

Approximate Station Locations, Transect 2, 1984 and 1985

Dames & Moore



LEGEND:

$\bullet_2$ Sampling Station

$)_5$ Beach Seine

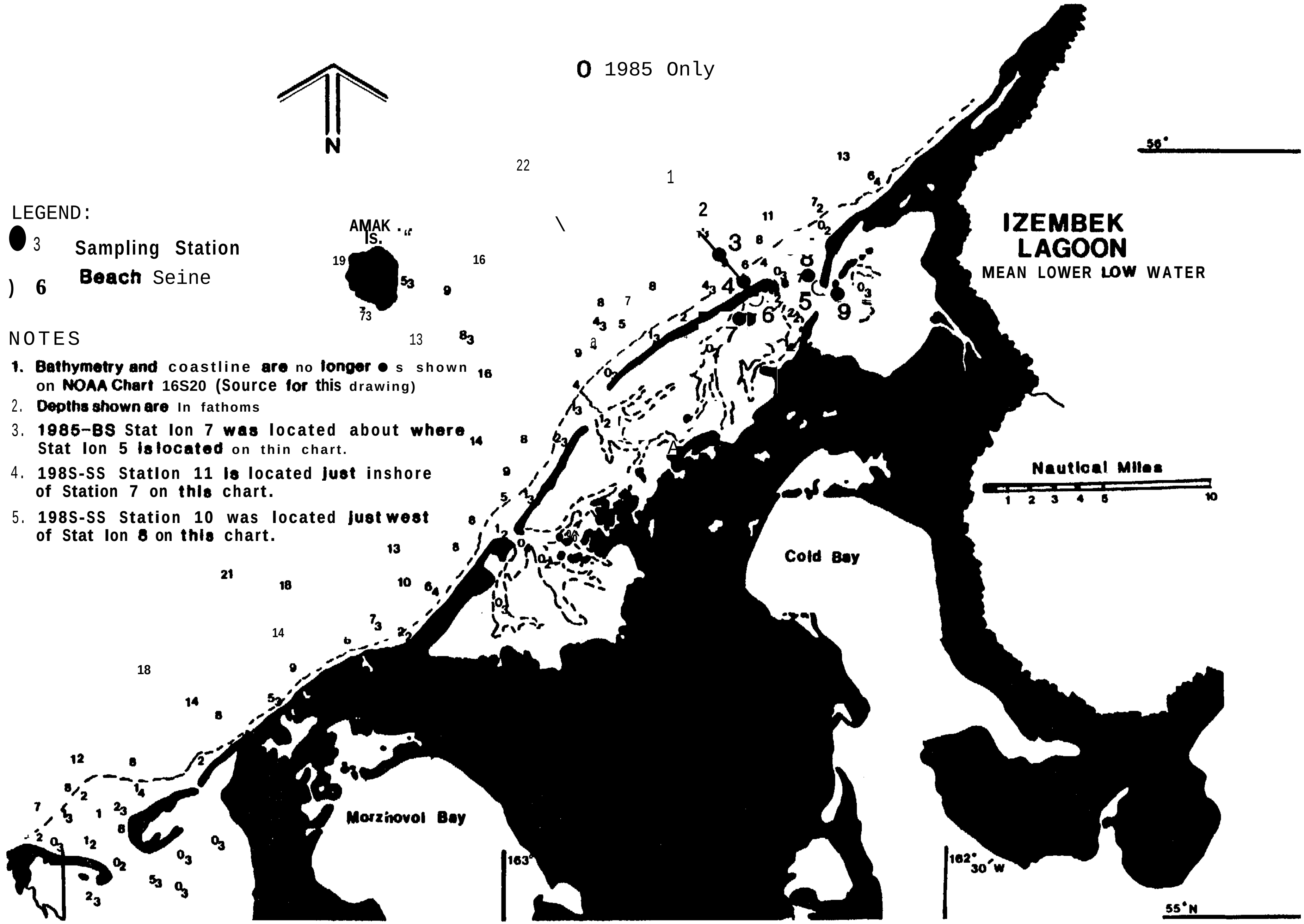
NOTE:

1. Bathymetry and coastline are no longer as shown on NOAA Chart 16363 (Source for this drawing)
2. Depths shown are in fathoms
3. Stations 10 and 11 - 1984 only, Stations 0,12, and 13 -1985 only

Approximate Station Locations, Transect 4, 1984 & 1985

Dames & Moore

Figure 4-3



Approximate Station Locations
Transect 6, 1984 & 1985

Figure A-4

Dames & Moore

APPENDIX B

PURSE SEINE CATCH DATA 1984

PURSE SEINE CATCH DATA

This appendix provides tables of purse seine catches of each species on each transect broken down by cruise and station. Data presented are means of the replicate taken at that station, transect, and cruise and are standardized to 10-minute opening time by multiplying the inverse of total time opened (lO-minute open + 1/2 time to close) by 10. For example, actual catch from a set that was held open into the current for 10 minutes and took 6 minutes to close would be multiplied by 0.77(10+ (10+3)) to obtain standardized catch (both weight and numbers). Approximate water surface area fished is 31,000 m^2 based on the standard 10-minute tow at 0.26 m/s (0.5 knots) with a 145-m net opening. Frequency of occurrence of (number of sets containing) each species is also provided along with a summary for each transect in each cruise.

For identification, a four-digit code is placed at the top of each column. The first digit identifies the cruise, the second the transect number and the last two digits are the station number.

Data from Cruises 1, 2, and 3 are contained in Tables B-1, B-2, and B-3, respectively.

APPENDIX TABLE B-1

PURSE SEINE CATCH DATA SUMMARY FOR CRUISE 1

Transect 2

Common Species Name	Station 2: 1202 Freq	Station 2: Mean Abund	Station 2: Mean Weight	Station 3: 1203 Freq	Station 3: Mean Abund	Station 3: Mean Weight	Transect Summary: Freq	Transect Summary: Mean Abund	Transect Summary: Mean Weight
empty haul	1.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0
PACIFIC HERRING	0.0	0.0	0.0	1.0	0.4	83.3	1.0	0.[illegible]	41.7
CHUM SALMON Juv	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.[illegible]	0.0
CHUM SALMON Adult	0.0	0.0	0.0	1.0	0.8	2751.5	1.0	0.[illegible]	1375.8
COHO SALMON Juv	0.0	0.0	0.0	2.0	62.6	3103.0	1.0	31.[illegible]	1551.5
SOCKEYE SALMON Juv	0.0	0.0	0.0	2.0	1.7	25.2	1.0	0.[illegible]	12.6
SOCKEYE SALMON Adult	1.0	12.7	28317.5	2.0	12.3	27355.2	2.0	12.[illegible]	27836.3
RAINBOW SMELT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.[illegible]	0.0
CODS UNID	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.[illegible]	0.0
PACIFIC COD	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.[illegible]	0.0
WALLEYE POLLOCK	0.0	0.0	0.0	0.[illegible]	0.0	0.0	0.0	0.[illegible]	0.0
WHITESPOTTED GREENLING	1.0	0.0	9.[illegible]	0.[illegible]	0.0	0.0	[illegible].0	0.[illegible]	5.0
STURGEON POACHER	0.0	1.4	0.0	0.0	0.0	0.[illegible]	[illegible].0	0.0	0.0
BERING POACHER	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PACIFIC SANDFISH	0.0	0.0	0.0	1.0	1.9	48.0	0.0	[illegible].0	24.0
SNAKE PRICKLEBACK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CRESCENT GUNNEL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PACIFIC SANDLANCE	0.0	0.0	0.0	1.0	17.0	64.[illegible]	[illegible].0	8.5	32.1
ROCK SOLE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
YELLOWFIN SOLE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
STARRY FLOUNDER	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Number of Species	2.0			7.0			8.0		
Mean Abundance		14.2			96.5			55.4	
Mean Weight (g)			28327.4			33430.3			30878.8
Number of Replicates			2.0			2.0			4.0

Transect 3

Common Species Name	Station 2: 1302 Freq	Station 2: Mean Abund	Station 2: Mean Weight	Station 3: 1303 Freq	Station 3: Mean Abund	Station 3: Mean Weight	Transect Summary: Freq	Transect Summary: Mean Abund	Transect Summary: Mean Weight
empty haul	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PACIFIC HERRING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CHUM SALMON Juv	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CHUM SALMON Adult	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
COHO SALMON Juv	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SOCKEYE SALMON Juv	1.0	4.4	42.9	0.0	0.0	0.0	1.0	0.2	21.4
SOCKEYE SALMON Adult	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
RAINBOW SMELT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CODS UNID	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PACIFIC COD	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0
WALLEYE POLLOCK	0.0	0.0	0.0	0.0	0.5	15.0	1.0	0.8	7.6
WHITESPOTTED GREENLING	0.0	0.0	0.7	1.0	0.0	0.[illegible]	1.0	0.2	0.4
STURGEON POACHER	0.0	0.0	0.0	2.0	0.0	0.0	0.0	0.0	0.0
BERING POACHER	0.0	0.0	0.0	1.[illegible]	0.8	3.8	1.0	0.4	1.9
PACIFIC SANDFISH	0.0	0.0	0.0	0.0	32.6	1185.3	1.0	16.3	392.7
SNAKE PRICKLEBACK	0.0	0.0	0.0	0.0	0.3	4.3	1.0	0.1	2.2
CRESCENT GUNNEL	0.0	0.0	0.0	2.0	0.0	0.0	0.0	0.0	0.0
PACIFIC SANDLANCE	0.0	0.0	0.0	0.0	11.6	58.2	1.0	5.8	29.1
ROCK SOLE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
YELLOWFIN SOLE	0.0	0.0	0.0	2.0	5.3	1300.9	1.0	2.6	650.4
STARRY FLOUNDER	[illegible]	0.0	0	1.0	0.3	57.5	1.0	0.1	28.7
Number of Species	2.0			7.0			9.0		
Mean Abundance		4.7			52.2			28.4	
Mean Weight (g)			43.6			2625.0			1334.3
Number of Replicates			2.0			2.[illegible]			4.0

Transect 4

Common Species Name	Station 1 1401 Freq	Station 1 Mean Abund	Station 1 Mean Weight	Station 2 1402 Freq	Station 2 Mean Abund	Station 2 Mean Weight	Station 3 1403 Freq	Station 3 Mean Abund	Station 3 Mean Weight	Transect Summary Freq	Transect Summary Mean Abund	Transect Summary Mean Weight
empty haul	1.0	O*O	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0
PACIFIC HERRING	0.0	0.0	0*0	0.0	O*O	0.0	0.0	0*0	0,0	0,0	0*0	0.0
CHUM SALMON Juv	0.0	0*0	0.0	0.0	0.0	0.0	0.0	0.0	0*0	0.0	0.0	0.0
CHUM SALMON Adult	0.0	0.0	0*0	0.0	0.0	0.0	0.0	0.0	0*0	0*0	0.0	0.0
COHO SALMON Juv	0.0	0.0	0.0	1.0	O*3	11.9	1.0	0,4	15.2	2.0	0*2	7.7
SOCKEYE SALMON Juv	1.0	1.2	19.5	1*O	4*3	67.8	2.0	6.1	93.1	3.0	3*5	54.3
SOCKEYE SALMON Adult	0.0	0.0	0*0	0.0	O*O	0.0	1.0	0.4	808.0	1.0	0.1	230.8
RAINBOW SMELT	0*0	0.0	0*0	0.0	0.0	0*0	1*0	1.8	90.6	1*0	0.5	2S.9
CODS UNID	0.0	0.0	0.0	0.0	0.0	0*0	0.0	0.0	0*0	0*0	0.0	0*0
PACIFIC COD	0.0	0.0	0*0	0.0	O*O	0.0	0*0	0*0	0*0	0*0	0.0	0*0
WALLEYE POLLOCK	0.0	0.0	0*0	O*O	0.0	0.0	0*0	0*0	0.0	0.0	0.0	0.0
WHITESPOTTED GREENLING	1.0	1.0	2*0	1*O	2.2	5.4	2*0	1.8	5.4	3.0	1.6	3.9
STURGEON POACHER	0.0	0.0	0*0	1.0	0.4	9.1	0.0	0.0	0.0	1.0	0*1	2.6
BERING POACHER	0*0	0.0	0.0	0.0	O*O	0.0	0.0	0*0	0.0	0.0	0.0	0.0
PACIFIC SANDFISH	1.0	0.2	25.2	2.0	1*O	136.7	0.0	0*0	0.0	2.0	0.4	49.9
SNAKE PRICKLEBACK	0*0	0.0	0.0	0.0	0.0	0.0	1*0	0.7	3.6	1.0	0.2	1.0
CRESCENT GUNNEL	0*0	0*0	0.0	O*O	O*O	0.0	1*0	1.8	7.2	1.0	0*5	2.1
PACIFIC SANDLANCE	1*0	2.5	25.2	0.0	0.0	0*0	1*0	0*4	0.7	2.0	1.2	11.0
ROCK SOLE	0.0	0*0	0*0	1.0	0.3	1.0	1*0	0.4	5.1	2*0	0.2	1.7
YELLOWFIN SOLE	1*0	0.2	21.7	0.0	0.0	0*0	1,0	0.4	7.2	2*0	0.2	11.4
STARRY FLOUNDER	0.0	0*0	0*0	0.0	0.0	0.0	0.0	0*0	0.0	0.0	0.0	0.0
Number of Species	5.0			6,0			10*0			12.0		
Mean Abundance		5.2			8.5			13.9			8.6	
Mean Weight (g)			93.7			231.7			1035.9			402.3
Number of Replicates			3*0			2.0			2.0			7.0

Transect 5

Common Species Name	Station 2 1502 Freq	Station 2 Mean Abund	Station 2 Mean Weight	Station 3 1s03 Freq	Station 3 Mean Abund	Station 3 Mean Weight	Transect Summary Freq	Transect Summary Mean Abund	Transect Summary Mean Weight
empty haul	0.0	0,0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PACIFIC HERRING	0.0	0*0	0*0	0.0	O*O	0.0	0.0	0.0	0.0
CHUM SALMON Juv	1.0	0,3	2.4	1.0	0.4	4.0	2.0	0*3	3.2
CHUM SALMON Adult	0.0	0.0	0.0	0.0	O*O	0*0	0.0	0.0	0.0
COHO SALMON Juv	0.0	0.0	0*0	0.0	O*O	0.0	0.0	0*0	0.0
SOCKEYE SALMON Juv	0.0	0.0	0.0	1.0	O*4	17.4	1.0	0*2	8.7
SOCKEYE SALMON Adult	0.0	0.0	0*0	0.0	0.0	0.0	0.0	0.0	0*0
RAINBOW SMELT	0.0	0.0	0*0	0.0	O*O	0.0	0.0	0*0	0*0
CODS UNID	1.0	6*9	3.5	2.0	51.8	45.3	2.0	29,4	24,4
PACIFIC COD	1.0	1.1	0.8	O*O	0.0	0,0	1.0	0.6	0,4
WALLEYE POLLOCK	1.0	0*4	0*4	1.0	12.3	10.9	2.0	6.3	5.6
WHITESPOTTED GREENLING	1.0	68.4	173.6	2.0	61.9	351.4	2.0	65.2	262. 5
STURGEON POACHER	0*0	0*0	0.0	0.0	0.0	0.0	0,0	0.0	0.0
BERING POACHER	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PACIFIC SANDFISH	0.0	0.0	0*0	0.0	O*O	0.0	0.0	0*0	0*0
SNAKE PRICKLEBACK	0.0	0.0	0.0	0,0	0.0	0*0	0.0	0.0	0*0
CRESCENT GUNNEL	0.0	0.0	0*0	0.0	0.0	0.0	0.0	0.0	0.0
PACIFIC SANDLANCE	0.0	0.0	0.0	1.0	2.2	29.0	1.0	1.1	14.5
ROCK SOLE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
YELLOWFIN SOLE	0.0	0*0	0.0	0.0	0.0	0*0	0.0	0.0	0.0
STARRY FLOUNDER	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0*0	0*0
Number of Species	5.0			6.0			7.0		
Mean Abundance		77.1			128.9			103.0	
Mean Weight (g)			180.6			457.8			319.2
Number of Replicates			2*0			2.0			4*0

APPENDIX TABLE B-Z

PURSE SEINE CATCH DATA SUMMARY FOR CRUISE 2

Transect 1

Common Species Name	Station 1 2101 Freq	Mean Abund	Mean Weight	Station 2 2102 Freq	Mean Abund	Mean Weight	Station 3 2103 Freq	Mean Abund	Mean Weight	Transect Summary Freq	Mean Abund	Mean Weight
empty haul	1*0	0.0	0.0	0*0	000	0.0	0.0	0*0	0.0	1.0	0.0	0.0
ARCTIC LAMPREY	0*0	O*O	0.0	1.0	0*4	19.8	1*0	2.8	41.3	2.0	1.0	20,4
PACIFIC HERRING	0.0	0.0	0.0	0.0	0.0	000	O*O	O*O	0.0	0*0	0.0	0.0
PINK SALMON Juv	0.0	0.0	0.0	0.0	0.0	0.0	O*O	0.0	0.0	0,0	0.0	0.0
PINK SALMON Adult	0.0	0.0	0*0	0.0	0*0	0.0	0.0	O*O	0.0	0*0	0*0	0.0
CHUM SALMON Juv	0.0	0.0	0.0	0.0	0*0	0*0	0.0	0.0	0*0	0.0	0.0	0.0
CHUM SALMON Adult	0.0	O*O	0.0	0.0	0*0	0*0	O*O	0.0	0*0	0*0	0.0	0.0
COHO SALMON Juv	0.0	0,0	0.0	0.0	000	0.0	O*O	0.0	0.0	0.0	0.0	0.0
SOCKEYE SALMON Juv	2.0	31.7	410.3	0.0	0*0	0*0	1*0	0.8	11.1	2,0	10.8	140.5
SOCKEYE SALMON Adult	0.0	0.0	0.0	1.0	0*4	809.5	0*0	0.0	0.0	1.0	0.1	269.8
CHINOOK SALMON Juv	0*0	O*O	0*0	0*0	0*0	0.0	0*0	0.0	0.0	0,0	0*0	0.0
00LL% VARDEN Adult	0.0	0.0	0.0	0*0	000	O*O	0.0	0*0	0.0	0*0	0.0	0.0
RAINBOW SMELT	0*0	O*O	0.0	0*0	0.0	0.0	0*0	0*0	0*0	0.0	0.0	0.0
ARCTIC COD	0*0	O*O	0.0	1.0	0*4	0.4	0.0	0.0	0*0	1.0	0*1	0*1
PACIFIC COD	0.0	O*O	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0*0	0.0	0.0
WALLEYE POLLOCK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
THREESPINE STICKLEBACK	0.0	0.0	0.0	0.0	0.0	0.0	0*0	0.0	0.0	0,0	0.0	0.0
WHITESPOTTED GREENLING	1.0	0.4	2.7	2.0	49.5	374.7	2*O	6.5	41.4	3.0	18*8	139.6
CRESTED SCULPIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0,0	0.0	0.0
SILVERSPOT SCULPIN	0.0	0.0	0.0	2.0	1.2	8*1	0.0	0.0	0.0	1*0	O*4	2.7
PACIFIC SANDFISH	0.0	O*O	0*0	0*0	0.0	O*O	1.0	0.8	64.4	1*0	0,3	21.5
WOLF-EEL	0*0	O*O	0*0	0.0	0.0	0.0	0.0	0.0	0.0	0*0	000	0.0
PACIFIC SANDLANCE	0*0	0.0	0.0	2*0	0.8	7.3	0.0	O*O	0.0	1.0	0.3	2.4
PLEURONECTIDAE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ROCK SOLE	0.0	O*O	0.0	0.0	0.0	O*O	0.0	0.0	0*0	0.0	O*O	0*0
YELLOWFIN SOLE	0*0	O*O	0.0	0*0	0.0	0.0	1*O	0.4	132.6	1*0	0.1	44*2
Number of Species	2.0			6.0			5.0			9.0		
Mean Abundance		32.0			52.5			11.1			31.8	
Mean Weight (g)			413.0			1219.6			290.7			641.1
Number of Replicates			2.0			2.0			2.0			6.0

APPENDIX TABLE B-2 (cont.)

Transect 3

Common Species Name	Station 1 2301 Freq	Station 1 Mean Abund	Station 1 Mean Weight	Station 2 2302 Freq	Station 2 Mean Abund	Station 2 Mean Weight	Station 3 2303 Freq	Station 3 Mean Abund	Station 3 Mean Weight	Transect Summary Freq	Transect Summary Mean Abund	Transect Summary Mean Weight
empty haul	O*O	O*O	O*O	0.0	0.0	O*O	0.0	0.0	0.0	0.0	0.0	0*0
ARCTIC LAMPREY	0.0	0.0	0.0	0.0	O*O	0.0	0.0	O*O	O*O	O*O	0.0	0.0
PACIFIC HERRING	1.0	0.4	36.2	1.0	O*4	14.3	O*O	0.0	0.0	2.0	0.2	17.5
PINK SALMON Juv	0*0	0.0	O*O	0.0	0.0	O*O	O*O	0.0	0.0	O*O	0,0	0.0
PINK SALMON Adult	0.0	O*O	0.0	1*O	0.4	687.9	1.0	O*4	515*9	2.0	O*2	401.3
CHUM SALMON Juv	2.0	34,3	271.2	2.0	10.5	73.5	1.0	3*6	28.6	3,0	16.1	124.4
CHUM SALMON Adult	0*0	0.0	0.0	1.0	O*4	1203.8	2.0	1.9	5363.8	2*O	0.8	2189,2
COHO SALMON Juv	1*0	0.4	18.8	2*O	1*1	50.3	0.0	O*O	0*0	2.0	0.5	23.0
SOCKEYE SALMON Juv	2*0	19.9	185.2	2.0	1400	07.7	1*O	6,0	28.2	3*O	13.3	100*3
SOCKEYE SALMON Adult	0*0	0.0	0.0	1*O	1,9	4643.2	1.0	3*I3	7566.7	2.0	1.9	4069.9
CHINOON SALMON Juv	2*0	5.4	42.9	2.0	1.1	49*O	0.0	0.0	0*0	2.0	2*1	30.6
DOLLY VARDEN Adult	0*0	0.0	0.0	1.0	0.4	144.9	0.0	O*O	0.0	1.0	0.1	48.3
RAINBOW SMELT	0*0	O*O	0.0	0.0	O*O	0.0	1*O	0.4	15.9	1.0	0.1	5.3
ARCTIC COO	0.0	0.0	0.0	0.0	0,0	O*O	0.0	O*O	0.0	O*O	0,0	0*0
PACIFIC COD	1*0	22.6	36.5	1*O	0.8	1.5	1.0	4.4	11.9	3*O	9.2	16*6
WALLEYE POLLOCK	1.0	105.2	163.2	2.0	14.3	23*?	2*O	69.7	96.9	3*O	63.1	94.6
THREESPINE STICKLEBACK	0.0	0.0	0.0	O*O	0.0	0.0	0.0	0.0	0*0	0.0	0*0	0*0
WHITESPOTTED GREENLING	1*0	1.0	5.2	2.0	78.9	280.4	2*O	68.4	429.4	3.0	49*4	238.3
CRESTED SCULPIN	0*0	O*O	0*0	0.0	O*O	0.0	0.0	0.0	0*0	0.0	0.0	0.0
SILVERSPOT SCULPIN	0*0	0.0	0,0	1.0	0.4	1.5	0.0	O*O	0*0	1.0	0*1	0.5
PACIFIC SANDFISH	000	O*O	0,0	1*O	2.7	151.5	1.0	0.4	11*4	2.0	1.0	54.3
WOLF-EEL	1.0	O*3	27.8	0.()	O*O	0.0	O*O	O*O	0*0	1*O	0.1	9.3
PACIFIC SANDLANCE	0.0	0.0	0.0	0.0	0.0	0.0	2.0	8.6	94.9	1*O	2.9	31.6
PLEURONECTIDAE	0.0	O*O	0.0	0.0	O*O	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ROCK SOLE	0*0	O*O	0*0	2.0	I*1	32.9	O*O	0.0	0.0	1.0	0*4	11.0
YELLOWFIN SOLE	0*0	0.0	0*0	1.0	0.4	113.6	0.0	0,0	0*0	1.0	0.1	37.9
Number of Species	9.0			16.0			11.0			19.0		
Mean Abundance		189.3			128.1			167.3			161.6	
Mean Weight (g)			786.7			7S61.6			14163.3			7503.s
Number of Replicate%			2.0			2.0			2.0			6.0

APPENDIX TABLE B-2 (cont.)

Transect 4 Common Species Name	Station 1 2401 Freq	Mean Abund	Mean Weight	Station 2 2402 Freq	Mean Abund	Mean Weight	Station 3 2403 Freq	Mean Abund	Mean Weight	Transect Summary Freq	Mean Abund	Mean Weight
empty haul	0.0	0.0	0.0	1.0	O*O	0.0	O*O	0.0	0.0	0*0	0.0	0.0
ARCTIC LAMPREY	0.0	0.0	0.0	0.0	O*O	0.0	O*O	0*0	O*O	0.0	0.0	0.0
PACIFIC HERRING	0.0	0*0	O*O	O*O	0.0	0.0	0.0	0*0	0.0	0*0	0.0	0.0
PINK SALMON Juv	1*O	2.1	25.8	0.0	0,0	0*0	O*O	0.0	0.0	1*0	0.7	8.6
PINK SALMON Adult	O*O	0.0	O*O	1.0	1.7	2149,6	000	0.0	O*O	I*0	006	716.5
CHUM SALMON Juv	0.0	0*0	0.0	0.0	O*O	0*0	0.0	0*0	0.0	0*0	0.0	0.0
CHUM SALMON Adult	0.0	0.0	O*O	1.0	044	860.0	0.0	0.0	O*O	1.0	0.1	286.7
COHO SALMON Juv	0.0	0.0	O*O	0.0	O*O	0*0	1*O	4.4	923.4	1*0	1.5	307.8
SOCKEYE SALMON Juv	1.0	0*8	11.7	2*O	0.8	10.8	0.0	0*0	O*O	2.0	0.5	7.5
SOCKEYE SALMON Adult	0.0	0*0	0.0	O*O	0,0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CHINOOK SALMON Juv	0.0	0.0	O*O	0.0	0.0	0*0	O*O	0.0	0.0	0*0	0.0	0.0
DOLLY VARDEN Adult	O*O	0*0	O*O	O*O	0,0	0.0	0.0	0.0	0.0	0*0	0.0	0.0
RAINBOW SMELT	O*O	0*0	0.0	O*O	O*O	0*0	0.0	0.0	O*O	0*0	O*O	0*0
ARCTIC COD	0.0	0*0	0.0	O*O	0,0	0*0	0.0	0*0	0.0	0,0	0.0	0.0
PACIFIC COD	2.0	42*1	91.7	1.0	0.8	3.3	0.0	0.0	0.0	2.0	14.3	31.7
WALLEYE POLLOCK	0.0	0*0	O*O	0.0	O*O	0*0	O*O	0.0	0.0	0.0	O*O	0.0
THREESPINE STICKLEBACK	0.0	0.0	O*O	O*O	O*O	0*0	1.0	0.4	0.4	1*0	0.1	0.1
WHITESPOTTED GREENLING	0.0	0.0	0.0	O*O	0,0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CRESTED SCULPIN	O*O	0.0	0.0	0.0	O*O	0*0	0.0	0*0	0.0	0*0	0,0	0*0
SILVERSPOT SCULPIN	1*O	0*8	33.3	0.0	000	0*0	0.0	0,0	O*O	1*0	0.3	11*1
PACIFIC SANDFISH	0.0	0.0	0.0	0.0	O*O	0*0	0.0	0*0	0.0	0*0	0.0	0.0
WOLF-EEL	0.0	0.0	0.0	0,0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PACIFIC SANDLANCE	O*O	0.0	0.0	1.0	O*4	2.1	2.0	7*9	31.7	2.0	2.8	11.3
PLEURONECTIDAE	O*O	0.0	0.0	0.0	0.0	0.0	0.0	0.0	O*O	0.0	0.0	0.0
ROCK SOLE	0.0	0*0	0.0	O*O	0.0	0.0	0,0	0.0	0.0	0.0	O*O	0*0
YELLOWFIN SOLE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0*0	0.0	0.0	0.0	0.0
Number of Species	4*O			5.0			3.0			9*0		
Mean Abundance		45.7			4.0			12.6			20.8	
Mean Weight (g)			162.4			3025.7			955.5			1381.2
Number of Replicates			2.0			2.0			2.0			6.0

APPENDIX TABLE B-2 (cont.)

Transect 5 Common Species Name	Station 1 2501 Freq	Mean Abund	Mean Weight	Station 2 2502 Freq	Mean Abund	Mean Weight	Station 3 2503 Freq	Mean Abund	Mean Weight	Transect Summary Freq	Mean Abund	Mean Weight
empty haul	0.0	0.0	0.0	O*O	O*O	0.0	0,0	0.0	0.0	0.0	O*O	0.0
ARCTIC LAMPREY	0.0	0.0	0.0	0.0	0.0	0.0	O*O	0.0	O*O	0.0	0.0	0.0
PACIFIC HERRING	0.0	0.0	0.0	0.0	O*O	0.0	O*O	0.0	0.0	0.0	O*O	0.0
PINK SALMON Juv	0.0	O*O	0.0	O*O	O*O	0.0	0.0	0.0	0.0	O*O	0.0	0.0
PINK SALMON Adult	0.0	O*O	O*O	0.0	0.0	0.0	O*O	0.0	0.0	0.0	0.0	0.0
CHUM SALMON Juv	O*O	0.0	0.0	0.0	0.0	0.0	O*O	0.0	O*O	O*O	0.0	0.0
CHUM SALMON Adult	0.0	O*O	O*O	0.0	O*O	0.0	O*O	O*O	O*O	O*O	0.0	0.0
COHO SALMON Juv	0.0	0.0	0.0	O*O	O*,O	0.0	O*O	O*O	0.0	0.0	0.0	0.0
SOCKEYE SALMON Juv	0.0	0.0	O*O	O*O	O*O	O*O	1*O	2.1	25.4	1*O	0.8	10.2
SOCKEYE SALMON Adult	0.0	0.0	O*O	.0.0	0.0	O*O	1.0	0.4	860.0	1*O	0.2	344.0
CHINOOK SALMON Juv	O*O	O*O	0.0	O*O	0.0	0.0	O*O	0.0	O*O	O*O	0.0	0*0
DOLLY VARDEN Adult	0.0	0.0	0.0	0.0	0.0	O*O	1,0	0.4	458.3	1.0	0.2	183.3
RAINBOW SMELT	0.0	0.0	0.0	0.0	O*O	O*O	0.0	0.0	0.0	O*O	0.0	0.0
ARCTIC COD	0.0	0.0	O*O	0.0	O*O	0.0	0.0	0.0	O*O	0.0	0.0	0.0
PACIFIC COD	1.0	182.6	869.5	2.0	495 .8	1241.9	2.0	2*O	2.4	3.0	235 +6	671.6
WALLEYE POLLOCK	O*O	0.0	0.0	0.0	O*O	O*O	0.0	0.0	0.0	0.0	O*O	0.0
THREESPINE STICKLEBACK	0.0	0.0	0.0	0*0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
WHITESPOTTED GREENLING	1.0	1.4	7,2	2.0	22.1	242.8	2*O	7.0	42*7	3*O	11*9	115.6
CRESTED SCULPIN	0.0	0.0	0.0	1.0	O*4	4.0	O*O	0.0	0.0	1*O	O*1	1.6
SILVERSPOT SCULPIN	0.0	0.0	O*O	0.0	O*O	O*O	0.0	0.0	0.0	O*O	O*O	0*0
PACIFIC SANDFISH	O*O	O*O	O*O	0.0	000	0.0	1.0	O*4	16*3	1.0	O*1	6.5
WOLF-EEL	O*O	0.0	0.0	0.0	O*O	0.0	O*O	0.0	0.0	0.0	O*O	0.0
PACIFIC SANDLANCE	0.0	O*O	0.0	0.0	O*O	0.0	0.0	0.0	0.0	O*O	O*O	0.0
PLEURONECTIDAE	1.0	1.4	1.4	0.0	0.0	0.0	0.0	O*O	O*O	1.0	0.3	0.3
ROCK SOLE	0.0	0.0	0.0	0.0	O*O	0.0	0.0	O*O	0.0	0.0	O*O	0.0
YELLOWFIN SOLE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Number of Species	3.0			3*O			6.0			8.0		
Mean Abundance		185.4			518.2			12.2			249.2	
Mean Weight (g)			878.1			1488.6			1405,1			1333.1
Number of Replicates			1*0			2.0			2.0			5.0

APPENDIX TABLE B-2 (cont.)

Transect 6

Common Species Name	Station 1 2601 Freq	Station 1 Mean Abund	Station 1 Mean Weight	Station 2 2602 Freq	Station 2 Mean Abund	Station 2 Mean Weight	Station 3 2603 Freq	Station 3 Mean Abund	Station 3 Mean Weight	Transect Summary Freq	Transect Summary Mean Abund	Transect Summary Mean Weight
empty haul	0.0	0.0	0*0	0.0	0*0	0.0	0,0	0.0	0*0	0.0	0,0	0*0
ARCTIC LAMPREY	0.0	0.0	0.0	0.0	0*0	0*0	0.0	0.0	0.0	0*0	0.0	0.0
PACIFIC HERRING	0.0	0*0	0.0	0,0	0.0	0*0	0.0	0.0	000	0.0	0*0	0.0
PINK SALMON Juv	0.0	0*0	0.0	0.0	0.0	0.0	O*O	0.0	0*0	0.0	0.0	0.0
PINK SALMON Adult	0*0	0.0	0*0	0.0	0*0	0.0	0.0	0*0	0.0	0*0	0.0	0.0
CHUH SALMON Juv	0.0	0.0	000	0.0	0*0	0*0	0.0	0*0	0.0	0.0	0,0	0.0
CHUM SALMON Adult	0.0	0.0	0.0	0.0	0.0	0*0	2.0	8.6	30610.1	1.0	2.9	10203,4
COHO SALMON Juv	0.0	0.0	0*0	0.0	0.0	0.0	1.0	3.6	34.9	1.0	1.2	11*6
SOCKEYE SALMON Juv	0*0	0.0	0*0	1*0	0.4	2.9	0.0	0.0	0*0	1.0	0.1	1*0
SOCKEYE SALMON Adult	0.0	0.0	0*0	000	0.0	0.0	000	0*0	0.0	0*0	0,0	0*0
CHINOOK SALMON Juv	0.0	0.0	0*0	0*0	0.0	0.0	O*O	0*0	0.0	0*0	0*0	0*0
DOLLY VARDEN Adult	0.0	0.0	0*0	0.0	0*0	0.0	O*O	0*0	0.0	0*0	0.0	0*0
RAINBOW SMELT	0*0	0.0	0.0	0.0	0*0	0*0	0.0	0.0	0.0	0,0	0*0	0.0
ARCTIC COD	0*0	0*0	0.0	0*0	0*0	0*0	0.0	0*0	0*0	0,0	0*0	0*0
PACIFIC COD	2.0	40,0	100.0	0.0	0.0	0*0	0.0	0.0	0.0	1.0	13.3	33*3
WALLEYE POLLOCK	0.0	0.0	0.0	0.0	0*0	0*0	O*O	0.0	0*0	0.0	0*0	0.0
THREESPINE STICKLEBACK	0*0	0.0	0*0	0*0	0.0	0.0	O*O	0.0	0.0	0.0	0*0	0.0
WHITESPOTTED GREENLING	2*0	6.6	37.5	2.0	21.0	88.0	1.0	0.4	2*1	3*0	?*3	42.5
CRESTED SCULPIN	1.0	0.4	4*6	1.0	0.4	8.0	O*O	0.0	0*0	2,0	0.3	4.2
SILVERSPOT SCULPIN	0.0	O*O	0.0	0*0	0.0	0.0	O*O	0*0	0,0	0.0	0*0	0.0
PACIFIC SANDFISH	2.0	27.9	1250.0	1.0	0*4	72.5	2.0	1.4	69.4	3.0	9.9	463.9
WOLF-EEL	0*0	O*O	0.0	1.0	0*4	99.2	0.0	0*0	0*0	1.0	0.1	33.1
PACIFIC SANDLANCE	0*0	0.0	0*0	2.0	13.5	58.1	1.0	19.0	119.0	2.0	11.1	5?.0
PLEURONECTIDAE	0.0	O*O	000	0*0	0.0	0*0	O*O	0.0	0.0	0*0	0*0	0.0
ROCK SOLE	0*0	0.0	0*0	0.0	0*0	0.0	0.0	0.0	0.0	0.0	0*0	0*0
YELLOWFIN SOLE	0*0	0.0	0.0	0.0	0.0	0*0	O*O	0.0	0*0	0.0	0*0	0.0
Number of Species	4.0			6.0			5.0			9.0		
Mean Abundance		74.9			35.9			33.9			48.2	
Mean Weight (g)			1392.0			32B .6			30835 .5			10832.0
Number of Replicates			2*0			2.0			2.0			6.0

APPENDI TABLE B-3

PURSE SEINE CATCH DATA SUMMARY FOR CRUISE 3

Transect 1

Common Species Name	Station 2 3102 Freq	Station 2 Mean Abund	Station 2 Mean Weight	Station 3 3103 Freq	Station 3 Mean Abund	Station 3 Mean Weight	Transect Summary Freq	Transect Summary Mean Abund	Transect Summary Mean Weight
ARCTIC LAMPREY	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PACIFIC HERRING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CHUM SALMON Juv	2.0	3.4	'09.3	2.0	50.8	1374.6	2.0	27.1	741.9
COHO SALMON Juv	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SOCKEYE SALMON Juv	1.0	0.4	14.5	2.0	2.5	36.2	2.0	1.5	25.3
CHINOOK SALMON Juv	0.0	0.0	0.0	1.0	0.4	15.4	1.0	0.2	7.7
SMELT UNID	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SURF SMELT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
RAINBOW SMELT	0.0	0.0	0.0	2.0	3.3	112.5	.0	1.7	56.2
PACIFIC COD	2.0	376.6	880.5	2.0	31.7	116.7	2.0	204.1	498.6
THREESPINE STICKLEBACK	0.0	0.0	0.0	0.0	0.0	0.0	0.	0.0	0.0
NINE-SPINE STICKLEBACK	0.0	0.0	0.0	2.0	0.0	7.5	1.0	4.0	3.7
WHITESPOTTED GREENLING	0.	0.0	0.0	0.0	7.9	0.0	0.0	0.0	0.0
CRESTED SCULPIN	1.0	0.3	0.8	1.0	0.0	70.8	2.0	1.3	68.3
PACIFIC SANDFISH	0.0	1.0	65.0	0.0	1.3	0.0	0.0	0.0	0.0
WOLF-EEL	2.0	0.3	10.3	0.	0.0	0.0	1.0	0.6	78.2
CRESCENT GUNNEL	0.0	1.0	56.0	0.0	0.0	0.0	0.0	0.0	0.0
PACIFIC SANDLANCE	1.0	0.3	0.7	1.0	0.0	1.3	2.0	32.1	21.5
STARRY FLOUNDER	0.0	63.0	41.0	1.0	0.8	406.3	1.0	0.2	203.1
ALASKA PLAICE	0.0	0.0	0.0	0.0	0.4	0.0	0.0	0.0	0.0
Number of Species	6.0			9.0			10.0		
Mean Abundance		446.2			99.0			272.6	
Mean Weight (g)			1267.0			2141.0			1704.4
Number of Replicates			2.0			2.0			4.0

Transect 2

Common Species Name	Station 1 3201 Freq	Station 1 Mean Abund	Station 1 Mean Weight	Station 2 3202 Freq	Station 2 Mean Abund	Station 2 Mean Weight	Station 3 3203 Freq	Station 3 Mean Abund	Station 3 Mean Weight	Transect Summary Freq	Transect Summary Mean Abund	Transect Summary Mean Weight
ARCTIC LAMPREY	0.0	0.0	0.0	1.0	0.4	8.3	0.0	0.0	0.0	1.0	0.1	2.8
PACIFIC HERRING	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.	2.1	1.0	0.1	0.7
CHUM SALMON Juv	1.0	0.4	2.9	1.0	1.7	51.7	2.0	2.	95.4	3.0	1.7	50.0
COHO SALMON Juv	0.0	0.0	0.0	1.0	0.4	54.6	0.0	0.	0.0	1.0	0.1	18.2
SOCKEYE SALMON Juv	2.0	1.7	15.3	0.0	0.0	0.0	0.0	0.	0.0	1.0	0.6	5.1
CHINOOK SALMON Juv	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SMELT UNID	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SURF SMELT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
RAINBOW SMELT	0.	0.0	0.0	0.0	0.0	0.0	2.0	5.0	125.0	.0	1.7	41.7
PACIFIC COD	1.0	0.4	0.4	2.0	22.9	58.3	2.0	32.0	75.0	3.0	18.7	44.6
THREESPINE STICKLEBACK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.	0.0	0.0	0.0	0.0
NINE-SPINE STICKLEBACK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
WHITESPOTTED GREENLING	2.0	3.4	17.3	0.0	0.0	0.0	0.0	0.	0.0	1.	1.1	5.8
CRESTED SCULPIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PACIFIC SANDFISH	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
WOLF-EEL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CRESCENT GUNNEL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PACIFIC SANDLANCE	0.0	0.0	0.0	2.0	15.[illegible]	85.[illegible]	2.0	14.0	41.7	2.0	10.6	42.3
STARRY FLOUNDER	0.0	0.0	0.0	0.0	0.0	0.0	2.0	0.3	91.6	.0	0.3	30.5
ALASKA PLAICE	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.8	0.8	.0	0.1	0.3
Number of Species	4.0			5.0			7.0			11.0		
Mean Abundance		5.9			40.8			58.6			35.1	
Mean Weight (g)			35.9			258.2			431.4			241.8
Number of Replicates			2.0			2.0			2.0			6.0

APPENDIX TABLE B-3 (cont.)

Transect 3

Common Species Name	Station 2 3302 Freq	Station 2 Mean Abund	Station 2 Mean Weight	Station 3 3303 Freq	Station 3 Mean Abund	Station 3 Mean Weight	Transect Summary Freq	Transect Summary Mean Abund	Transect Summary Mean Weight
ARCTIC LAMPREY	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PACIFIC HERRING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CHUM SALMON Juv	2.0	0.8	26.[illegible]	1.0	0.8	12.1	2.0	0.8	19.4
COHO SALMON Juv	1.0	0.4	9.[illegible]	0.0	0.0	0.0	1.0	.2	4.6
SOCKEYE SALMON Juv	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CHINOOK SALMON Juv	0.0	0.0	0.0	1.0	0.4	49.6	1.0	0.2	24.8
SMELT UNID	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SURF SMELT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
RAINBOW SMELT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PACIFIC COD	2.0	6.2	10.[illegible]	1.0	0.4	0.8	2.0	3.3	5.4
THREESPINE STICKLEBACK	0.0	0.0	0.0	0.	0.0	0.0	0.0	0.0	0.0
NINE-SPINE STICKLEBACK	0.0	0.0	0.	0.0	0.0	0.0	0.0	0.0	0.0
WHITESPOTTED GREENLING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CRESTED SCULPIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PACIFIC SANDFISH	0.0	0.0	0.0	1.0	0.4	1.3	1.0	0.2	0.6
WOLF-EEL	0.0	0.0	0.0	1.0	0.4	30.7	1.0	0.2	15.4
CRESCENT GUNNEL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PACIFIC SANDLANCE	2.0	3.3	19.[illegible]	2.0	116.5	1000.2	2.0	59.9	509.9
STARRY FLOUNDER	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ALASKA PLAICE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Number of Species	4.0			6.0			7.0		
Mean Abundance		10.7			118.9			64.8	
Mean Weight (g)			65.3			1094.6			579.9
Number of Replicates			2.0			2.0			4.0

Transect 4

Common Species Name	Station 2 3402 Freq	Station 2 Mean Abund	Station 2 Mean Weight	Station 3 3403 Freq	Station 3 Mean Abund	Station 3 Mean Weight	Transect Summary Freq	Transect Summary Mean Abund	Transect Summary Mean Weight
ARCTIC LAMPREY	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PACIFIC HERRING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CHUM SALMON Juv	0.0	0.0	0.0	2.0	2.3	38.9	1.0	1.1	19.4
COHO SALMON Juv	1.0	0.5	27.8	0.0	0.0	0.0	1.0	0.2	13.9
SOCKEYE SALMON Juv	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CHINOOK SALMON Juv	0.0	0.0	0.0	1.0	0.5	41.7	1.0	0.2	20.8
SMELT UNID	0.0	0.0	0.0	2.0	14.3	23.1	1.0	7.2	11.6
SURF SMELT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
RAINBOW SMELT	0.0	0.0	0.0	2.0	3.7	83.3	1.0	1.8	41.7
PACIFIC COD	1.0	10.7	23.8	2.0	9.6	27.7	2.0	10.2	25.8
THREESPINE STICKLEBACK	1.	0.5	0.5	1.	0.5	0.5	2.0	0.5	0.5
NINE-SPINE STICKLEBACK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
WHITESPOTTED GREENLING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CRESTED SCULPIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PACIFIC SANDFISH	1.0	4.4	23.8	2.0	1.8	6.0	2.0	3.1	14.9
WOLF-EEL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CRESCENT GUNNEL	0.0	0.0	0.0	1.0	0.5	18.5	1.0	0.2	9.3
PACIFIC SANDLANCE	2.0	16.4	158.6	2.0	45.3	138.9	2.0	30.8	148.7
STARRY FLOUNDER	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ALASKA PLAICE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Number of Species	5.0			9.0			10.0		
Mean Abundance		32.3			78.3			55.3	
Mean Weight (g)			234.4			37[illegible].4			306.4
Number of Replicates			2.0			2.0			4.0

Transect 5

Common Species Name	Station 3 3503 Freq	Station 3 Mean Abund	Station 3 Mean Weight	Transect Summary Freq	Transect Summary Mean Abund	Transect Summary Mean Weight
ARCTIC LAMPREY	0.0	0.0	0*0	0.0	0*0	0.0
PACIFIC HERRING	0.0	0.0	0.0	0.0	0.0	000
CHUM SALMON Juv	0.0	0.0	0.0	0.0	0.0	0*0
COHO SALMON Juv	0.0	0.0	0.0	0.0	0.0	0*0
SOCKEYE SALMON Juv	0.0	0.0	0.0	0.0	0.0	0.0
CHINOOK SALMON Juv	0.0	0.0	0*0	0.0	0*0	0*0
SMELT UNID	0.0	0.0	0.0	0*0	0*0	0.0
SURF SMELT	0.0	0.0	0.0	0.0	0.0	0*0
RAINBOW SMELT	0.0	0.0	0.0	0.0	0.0	0*0
PACIFIC COD	1*0	2.3	11.6	1.0	2.3	11.6
THREESPINE STICKLEBACK	0*0	0*0	0.0	0*0	0*0	0.0
NINE-SPINE STICKLERACK	0.0	0.0	0.0	0.0	0.0	0.0
WHITESPOTTED GREENLING	1.0	0*S	1.4	1.0	0.5	1*4
CRESTED SCULPIN	1.0	0*S	11.6	1*0	0*5	11.6
PACIFIC SANDFISH	1.0	2.3	75*EI	1.0	2.3	75.8
WOLF-EEL	0.0	0.0	0.0	0*0	0.0	0.0
CRESCENT GUNNEL	0*0	0*0	0.0	0.0	0.0	0.0
PACIFIC SANDLANCE	1*0	5.1	74.1	1.0	5*1	74,1
STARRY FLOUNDER	0.0	0.0	0.0	0.0	0.0	0.0
ALASKA PLAICE	0.0	0.0	0,0	0$0	0.0	0.0
Number of Species	5.0			5.0		
Mean Abundance		10*5			10.5	
Mean Weight (g)			174*3			174.3
Number of Replicates			2.0			2.0

Transect 6

Common Species Name	Station 2 3602 Freq	Station 2 Mean Abund	Station 2 Mean Weight	Station 3 3603 Freq	Station 3 Mean Abund	Station 3 Mean Weight	Transect Summary Freq	Transect Summary Mean Abund	Transect Summary Mean Weight
ARCTIC LAMPREY	0*0	0.0	0*0	0.0	0.0	0*0	0.0	0.0	0.0
PACIFIC HERRING	0.0	0.0	0.0	0.0	0.0	0*0	0*0	0*0	0.0
CHUM SALMON Juv	0.0	0.0	0*0	0.0	0.0	0*0	0.0	0*0	0.0
COHO SALMON Juv	0.0	0*0	0*0	0.0	0.0	0.0	0.0	0.0	0.0
SOCKEYE SALMON Juv	0.0	0.0	0*0	0.0	0*0	0.0	0,0	0*0	0.0
CHINOOK SALMON Juv	0.0	0.0	0.0	0*0	0.0	0.0	0*0	0.0	0.0
SMELT UNID	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SURF SMELT	1.0	0.8	8.3	0.0	0.0	0.0	1*0	0.3	2.8
RAINBOW SMELT	0.0	0.0	0*0	0.0	0.0	0.0	0*0	0.0	0*0
PACIFIC COD	I*0	40.0	141.6	1*0	6.1	17.5	2.0	17.4	58*9
THREESPINE STICKLEBACK	0.0	0*0	0,0	0.0	0.0	0*0	0.0	0*0	0*0
NINE-SPINE STICKLEBACK	0*0	0.0	0.0	0*0	000	0*0	0.0	0*0	0.0
WHITESPOTTED GREENLING	1.0	2.5	16.6	1.0	0*4	1.3	2.0	1*1	6.4
CRESTED SCULPIN	0.0	0.0	0*0	0.0	0.0	0*0	0.0	0.0	0.0
PACIFIC SANDFISH	0.0	0.0	0*0	2.0	38.6	278.5	1*0	25.7	185.7
WOLF-EEL	0.0	0.0	0*0	0.0	0.0	0.0	0.0	0.0	0*0
CRESCENT GUNNEL	0.0	0.0	000	1.0	0*4	0.4	1.0	0.3	0.3
PACIFIC SANDLANCE	1.0	15.8	83*3	2.0	86.4	267.5	2.0	62.9	206.1
STARRY FLOUNDER	0.0	0*0	0.0	1.0	0.4	63.6	1.0	0.3	42.4
ALASKA PLAICE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Number of Species	4.0			6.0			7.0		
Mean Abundance		59,1			132.3			107.9	
Mean Weight (g)			249.8			628.7			502.4
Number of Replicates			1.0			2.0			3.0

APPENDIX C

TOW NET CATCH DATA 1984

TOW NET CATCH DATA

This appendix provides tables of tow net catches of each species on each transect broken down by cruise and station. Data presented are means of the replicate taken at that station, transect, and cruise and are all based on catch per 10-minute tow. Frequency of occurrence of (number of sets containing) each species is also provided along with a summary for each transect in each cruise.

For identification a four-digit code is placed at the top of each column. The first digit identifies the cruise, the second the transect number and the last two digits are the station number.

Data from Cruises 1, 2, and 3 are contained in Tables C-1, C-2, and C-3, respectively.

APPENDIX TABLE C-1

TOW NET CATCH DATA SUMMARY FOR CRUISE 1

Transect 3

Common Species Name	Station 3 1503 Freq	Station 3 Mean Abund	Station 3 Mean Weight	Station 4 1 3(-)4 Freq	Station 4 Mean Abund	Station 4 Mean Weight,	Transect Summary Freq	Transect Summary Mean Abund	Transect Summary Mean Weight
empty haul	0.0	0.(-)	0.0	0.0	0.0	0.0	0.0	0.0	().0
PACIFIC HERRING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SOCKEYE SALMON Juv	1.0	0.5	7.0	0.0	0.0	0.0	1.0	().3	3.5
RAINBOW SMELT	0.0	0.0	0.()	0.0	0.0	0.0	0.0	0.0	0.0
WHITESPOTTED GREENLING	1.0	0.5	4*0	0.0	0.0	0.0	1.0	0.3	2.0
PACIFIC SANDFISH	0.0	0.0	0.0	2*0	14*0	412.5	1.0	7.0	206.3
SNAKE PRICKLEBACK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	().0
PACIFIC SANDLANCE	2.0	880.0	2125.0	2.0	1987.0	4808.0	2.0	1433.5	3466.5
FLATHEAD SOLE	0.0	0.0	0.0	0*0	0.0	0.0	0*0	0.0	0.0
YELLOWFIN SOLE	0.0	0.0	0.0	2.0	9.5	1800.0	1.0	4.8	900 ,0
Number of Species	3.0			3.0			5.0		
Mean Abundance		881.0			2010.5			1445.8	
Mean Weight (g)			2136.0			7020.5			4578.3
Number of Replicates			2.0			2.0			4.0

Transect 4

Common species Name	Station 2 1402 Freq	Station 2 Mean Abund	Station 2 Mean Weight	Station 4 1404 Freq	Station 4 Hean Abund	Station 4 Mean Weight	Station 7 1407 Freq	Station 7 Mean Abund	Station 7 Mean Weight	Station 11 1411 Freq	Station 11 Mean Abund	Station 11 Mean Weight
empty haul	1.0	0.0	0.0	1*0	0*0	0.0	2*0	0*0	0.0	1*0	0*0	0*0
PACIFIC HERRING	0.0	0*0	0.0	0*0	0.0	0.0	0.0	0*0	0.0	1.0	0.5	10.0
SOCKEYE SALMON Juv	0*0	0*0	0*0	0.0	0*0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
RAINBOW SMELT	0*0	0*0	0.0	0.0	0*0	0*0	0.0	0*0	0.0	1.0	1.0	3s.0
WHITESPOTTED GREENLING	0.0	0.0	0.0	0.0	0.0	0*0	0.0	0*0	0.0	0.0	0.0	0,0
PACIFIC SANDFISH	0*0	0*0	0.0	0*0	0*0	0.0	0.0	0*0	0*0	0*0	0.0	0,0
SNAKE PRICKLEBACK	0.0	0.0	0*0	0.0	0.0	0*0	0.0	000	0.0	1.0	0.5	5.0
PACIFIC SANDLANCE	1*0	1.5	7.5	1.0	2*0	5.0	0*0	0*0	0.0	0*0	0*0	0.0
FLATHEAD SOLE	0.0	0*0	0*0	0*0	0*0	0*0	0*0	0*0	0.0	1*0	0.5	12.5
YELLOWFIN SOLE	0*0	0.0	0*0	0,0	0.0	0*0	0*0	0.0	0.0	0.0	0.0	0.0
Number of Species	2,0			2.0			1*0			5.0		
Mean Abundance		1.5			2.0			0*0			2.5	
Mean Weight (g)			7*S			5.0			0*0			62.5
Number of Replicates			2*0			2.0			2.0			2.0

APPENDIX TABLE C-1 (cont.)

Transect 4 (cont.)

Common Species Name	Freq	Mean Abund	Mean Weight
empty haul	0.0	0*0	0.0
PACIFIC HERRING	1*0	0*1	2.5
SOCKEYE SALMON Juv	0,0	0.0	0.0
RAINBOW SMELT	1.0	0*3	8.8
WHITESPOTTED GREENLING	0.0	0.0	0.0
PACIFIC SANDFISH	0.0	0*0	0.0
SNAKE PRICKLEBACK	1.0	0*1	1.3
PACIFIC SANDLANCE	2*0	0.9	3.1
FLATHEAD SOLE	1.0	0*1	301
YELLOWFIN SOLE	0.0	0*0	0.0
Number of Species	S*O		
Mean Abundance		1*S	
Mean Weight (q)			18.8
Number of Replicates			8.0

APPENDIX TABLE C-2

TOW NET CATCH DATA SUMMARY FOR CRUISE 2

Transect 0

Common Species Name	Station 8: 200s Freq	Station 8: Mean Abund	Station 8: Mean Weight	Transect Summary: Freq	Transect Summary: Mean Abund	Transect Summary: Mean Weight.
empty haul	0.0	0.0	0.0	0,0	0.0	0.()
ARCTIC LAMPREY	2.0	2.0	34.0	1.0	2.0	34.0
CHUM SALMON Juv	2.0	15.0	77.0	1.0	15.0	77.0
SOCKEYE SALMON Juv	0.0	0.0	0.0	0.0	0.0	0.0
CHINOOK SALMON Juv	1.0	0.5	4.0	1.0	0.5	4.0
SMELT UNID	0.0	0.0	0.0	0.0	0*0	0.0
RAINBOW SMELT	2.0	3500.0	22680.0	1.0	3500.0	22680.0
PACIFIC COD	0*0	0*0	0.0	0.0	0*0	0.0
NINE-SPINE STICKLEBACK	1.0	12.0	10.0	1.0	12.0	10.0
WHITESPOTTED GREENLING	2.0	1.0	6.5	1.0	1*0	6.5
PLAIN SCULPIN	1.0	0.5	220.0	1*0	0.5	220.0
SNAKE PRICKLEBACK	1*0	2.0	22.5	1.0	2.0	22.5
PACIFIC SANDLANCE	0.0	0*0	0.0	0.0	0.0	0.0
PLEURONECTIDAE	0*0	0.0	0.0	0.0	0.0	0.0
YELLOWFIN SOLE	1.0	0.5	145.0	1.0	0.5	145.0
STARRY FLOUNDER	2.0	5.5	2600 , 0	1.0	5.5	2600.0
Number of Species	10*0			10.0		
Mean Abundance		3539.0			3539 . 0	
Mean Weight (g)			25799.0			25799. 0
Number of Replicates			2.0			2.0

Tansect 1

Common Species Name	Station 3: 2103 Freq	Station 3: Mean Abund	Station 3: Mean Weight	Station 4: 2104 Freq	Station 4: Mean Abund	Station 4: Hean Weight	Transect Summary: Freq	Transect Summary: Mean Abund	Transect Summary: Mean Weight
empty haul	2*0	0*0	0.0	O*O	0.0	0.0	0.0	O*O	0.0
ARCTIC LAMPREY	0*0	0.0	O*O	O*O	O*O	0.0	O*O	0.0	0.0
CHUM SALMON Juv	0.0	0*0	0.0	0.0	0.0	O*O	0.0	0.0	O*O
SOCKEYE SALMON Juv	0.0	0.0	0.0	O*O	O*O	O*O	0.0	O*O	O*O
CHINOOK SALMON Juv	0.0	0.0	O*O	0.0	0.0	0.0	0,0	0.0	0.0
SMELT UNID	0.0	0.0	0.0	O*O	0.0	O*O	O*O	0.0	0.0
RAINBOW SMELT	0*0	0*0	0.0	1.0	4.0	25*0	1.0	2.0	12.5
PACIFIC COD	0*0	0*0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NINE-SPINE STICKLEBACK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0*0	0.0
WHITESPOTTED GREENLING	0*0	0*0	O*O	0.0	0*0	0.0	O*O	0*0	0*0
PLAIN SCULPIN	0*0	0.0	0.0	0.0	0.0	0*0	0.0	0*0	0*0
SNAKE PRICKLEBACK	0.0	0*0	O*O	0.0	0*0	0.0	O*O	0*0	0*0
PACIFIC SANDLANCE	0.0	0.0	0.0	2*0	39.0	60.0	1.0	19.5	30.0
PLEURONECTIDAE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
YELLOWFIN SOLE	0*0	0*0	0,0	0.0	0*0	0*0	0.0	0.0	0*0
STARRY FLOUNDER	0*0	0.0	O*O	0*0	0.0	0.0	O*O	0.0	0*0
Number of Species	1.0			2.0			2*O		
Mean Abundance		0.0			43.0			21.5	
Mean Weight (y)			0*0			85.0			42,5
Number of Replicates			2.0			2.0			4*0

APPENDIX TABLE C-2 (cont.)

Transect 3

Common Species Name	Station 3 2303 Freq	mean Abund	Mean Weight	Station 4 2304 Freq	Abund	Mean Weight	Transect Summary Freq	Mean Abund	Mean Weight
empty haul	0*0	0*0	0.0	0.0	0.0	0.0	0.0	0.0	0*0
ARCTIC LAMPREY	0*0	0.0	0.0	0.0	0*0	0*0	0*0	0*0	0.0
CHUM SALMON Juv	0*0	0*0	0*0	0.0	0.0	0.0	0*0	0*0	0*0
SOCKEYE SALMON Juv	0.0	0.0	0.0	0*0	0.0	0*0	0*0	0*0	0.0
CHINOOK SALMON Juv	1*0	1.0	6.0	0*0	0*0	0.0	1.0	0.s	3.0
SMELT UNID	0*0	0,0	0.0	0.0	0*0	0.0	0.0	0,0	0.0
RAINBOW SMELT	1.0	2*0	275 .0	1.0	3*0	125.0	2.0	2.5	200.0
PACIFIC COD	0.0	0.0	0*0	0.0	0.0	0.0	0.0	0*0	0*0
NINE-SPINE STICKLEBACK	000	0.0	0.0	0.0	0*0	0*0	0.0	0.0	0.0
WHITESPOTTED GREENLING	0.0	0.0	0.0	0.0	0*0	0*0	0.0	0*0	0*0
PLAIN SCULPIN	0.0	0.0	0.0	0.0	000	0.0	0.0	0.0	0*0
SNAKE PRICKLEBACK	0.0	0.0	0.0	0.0	0*0	0.0	0.0	0.0	0*0
PACIFIC SANDLANCE	2.0	20.0	65.0	2.0	110*5	95*0	2*0	65.3	80.0
PLEURONECTIDAE	1.0	0,5	0.5	0.0	0*0	0.0	1*0	0*3	0*3
YELLOWFIN SOLE	0*0	0.0	0,0	0.0	0*0	0*0	0*0	0*0	0.0
STARRY FLOUNDER	1.0	0.5	250.0	0.0	0*0	0*0	1.0	0.3	125*0
Number of Species	5.0			2*O			5.0		
Mean Abundance		24.0			113.s			68.8	
Mean Weight (g)			596.5			220*0			400 .3
Number of Replicates			2*0			2*0			4*0

Transect 4

Common Species Name	Station 3 2403 Freq	Mean Abund	Mean Weight	Station 4 2404 Freq	Mean Abund	Mean Weight	Station 7 2407 Freq	Mean Abund	Mean Weight	Station 10 2410 Freq	Mean Abund	Mean Weight
empty haul	1.0	0.0	0.0	O*O	0.0	0.0	0.0	0*0	0.0	0.()	0.0	0.0
ARCTIC LAMPREY	0*0	0.0	O*O	0.0	0.0	0*0	0.0	0.0	0.0	0.0	0*0	0.0
CHUM SALMON Juv	0.0	0*0	0.0	O*O	O*O	0*0	0*0	0.0	0,0	1.0	1.0	10.0
SOCKEYE SALMON Juv	0.0	0.0	O*O	0.0	O*O	0.0	0.0	0*0	C)*O	0*0	0.0	0.0
CHINOON SALMON Juv	0*0	0.0	0.0	0.0	000	0.0	0,0	0*0	O*O	0.0	0*0	0*0
SMELT UNID	0.0	0.0	0.0	1.0	7.5	1*5	0*0	0.0	O*O	0*0	0.0	0.0
RAINBOW SMELT	0.0	000	0.0	0.0	0*0	0*0	0.0	0*0	0.0	0.0	0.0	0.0
PACIFIC COD	0.0	0*0	O*O	0.0	0.0	0*0	000	0 .0	O*O	0*0	0*0	0.0
NINE-SPINE STICKLEBACK	0.0	0.0	0$0	0.0	000	0.0	0*0	0.0	O*O	0.0	0.0	0.0
WHITESPOTTED GREENLING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	O*O	0.0	0.0	0*0
PLAIN SCULPIN	0.0	0*0	0.0	0.0	0.0	000	0*0	0.0	0.0	0.0	0.0	0.0
SNAKE PRICKLEBACK	0.0	0.0	0.0	0.0	0.0	0*0	0.0	0*0	O*O	0.0	0.0	0,0
PACIFIC SANDLANCE	1.0	1638.5	1695.0	2.0	691.0	850.0	2.0	2886 .0	3550.0	2.0	781.0	2425.0
PLEURONECTIDAE	0*0	0.0	0.0	0*0	0.0	0.0	0*0	0.0	0*0	0.0	0.0	0.0
YELLOWFIN SOLE	0.0	0*0	0.0	0*0	0.0	0.0	0.0	0.0	0*0	0.0	0.0	0.0
STARRY FLOUNDER	1.0	0.5	250.0	0.0	0.0	0.0	0.0	0*0	0*0	0*0	0.0	0.0
Number of Species	3.0			2.0			1.0			2.0		
Mean Abundance		1639*0			698 .5			2S86 .0			782 .0	
Mean Weight (y)			1945.0			851.5			3550 . 0			2435.0
Number of Replicates			2.0			2*O			2.0			2.0

APPENDIX TABLE C-2 (cont.)

Transect 4 (cont.)

Common Species Name	Station 11 2411 Freq	Mean Abund	Mean Weight	Transect Summary Freq	Mean Abund	Mean Weight
empty haul	0.0	0.0	0.0	O*O	O*O	0.0
ARCTIC LAMPREY	0.0	0.0	0.0	0.0	0.0	0.0
CHUM SALMON Juv	O*O	O*O	O*O	1.0	0.2	2.0
SOCKEYE SALMON Juv	O*O	O*O	O*O	O*O	0.0	O*O
CHINOOK SALMON Juv	0.0	0.0	O*O	O*O	O*O	0.0
SMELT UNID	O*O	0.0	O*O	1*O	1*5	0.3
RAINROW SMELT	0.0	0.0	0.0	0.0	0.0	O*O
PACIFIC COD	O*O	0.0	O*O	O*O	0.0	0.0
NINE-SPINE STICKLEBACK	0.0	O*O	O*O	0.0	0.0	0.0
WHITESPOTTED GREENLING	O*O	O*O	O*O	0.0	0.0	0.0
PLAIN SCULPIN	0.0	O*O	0,0	0.0	O*O	0.0
SNAKE PRICKLEBACK	O*O	O*O	0.0	0.0	0.0	0.0
PACIFIC SANDLANCE	2.0	980.5	2352.5	5.0	1395.4	2174.5
PLEURONECTIDAE	0.0	O*O	0.0	O*O	O*O	O*O
YELLOWFIN SOLE	0.0	0.0	0.0	0.0	0.0	0.0
STARRY FLOUNDER	O*O	0.0	0.0	1.0	0.1	50.0
Number of Species	1.0			4.0		
Mean Abundance		980.5			1397.2	
Mean Weight (g)			2352.5			2226.0
Number of Replicates			2.0			10*O

Transect 6

Common Species Name	Station 8 2608 Freq	Mean Abund	Mean Weight	Transect Summary Freq	Mean Abund	Mean Weight
empty haul	O*O	0.0	O*O	0.0	0,0	O*O
ARCTIC LAMPREY	O*O	O*O	0.0	0.0	O*O	O*O
CHUM SALMON Juv	0,0	0.0	0.0	O*O	0.0	O*O
SOCKEYE SALMON Juv	1*O	3.5	22.s	1*O	3.5	22.5
CHINOOK SALMON Juv	0.0	O*O	O*O	0.0	O*O	0.0
SMELT UNID	O*O	O*O	O*O	0.0	0.0	0.0
RAINBOW SMELT	0.0	O*O	0.0	0.0	0.0	0.0
PACIFIC COD	1.0	0.5	1.5	1.0	0.5	1.5
NINE-SPINE STICKLEBACK	O*O	O*O	0.0	O*O	O*O	0.0
WHITESPOTTED GREENLING	2.0	2.0	6.s	1.0	2*O	6.5
PLAIN SCULPIN	O*O	0.0	0.0	O*O	O*O	0.0
SNAKE PRICKLEBACK	0.0	O*O	0.0	0.0	O*O	0.0
PACIFIC SANDLANCE	1.0	1.0	2.5	1.0	1*O	2*S
PLEURONECTIDAE	0.0	O*O	0.0	0.0	O*O	O*O
YELLOWFIN SOLE	0.0	O*O	O*O	0.0	0,0	0.0
STARRY FLOUNDER	0.0	O*O	0.0	O*O	0,0	O*O
Number of Species	4*O			4*O		
Mean Abundance		7.0			7*O	
Mean Weight (g)			33.0			33.0
Number of Replicates			2.0			2.0

APPENDIX TABLE C-3

TOW NET CATCH DATA SUMMARY FOR CRUISE 3

Transect 4

Common Species Name	Station 4 .3404 Freq	Mean Abund	Mean Weight	Station 7 3407 Freq	Mean Abund	Mean Weight	Transect Summary Freq	Mean Abund	Mean Weight
PACIFIC HERRING	2.0	102.()	95.0	2.0	268.5	347.5	2.0	185.3	221.3
PACIFIC COD	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	().0
CRESTED SCULPIN	1.0	0.5	30.0	0.0	0.0	().0	1.0	0.3	15.0
TUBENOSE POACHER	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LIPARIS SP	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PACIFIC SANDLANCE	2.0	1.5	4.0	1.0	2.0	10.0	2.0	1.8	7*O
STARRY FLOUNDER	0.0	0.0	0.0	2*O	1,0	280.0	1*O	0.5	140.0
Number of Species	3.0			3.0			4*O		
Mean Abundance		104.0			271. S			187.8	
Mean Weight (g)			129.0			637.5			383.3
Number of Replicates			2.0			2.0			4*O

Transect 6

Common Species Name	Station 7 3607 Freq	Mean Abund	Mean Weight	Transect summary Freq	Hean Abund	Mean Weight
PACIFIC HERRING	O*O	O*O	0.0	O*O	O*O	0.0
PACIFIC COD	2.0	1.s	3.0	1,0	1.s	3.0
CRESTED SCULPIN	0.0	O*O	0.0	0.0	O*O	0.0
TUBENOSE POACHER	1*O	O*5	0.5	1.0	0.5	0.s
LIPARIS 6P	1.0	0.5	O*5	1.0	O*5	0.5
PACIFIC SANDLANCE	0,0	0.0	0.0	0.0	0.0	000
STARRY FLOUNDER	0.0	0.0	O*O	O*O	O*O	0.0
Number of Species	3.0			3*O		
Mean Abundance		2.5			2.5	
Mean Weight (g)			4.0			4.0
Number of Replicates			2.0			2*O

APPENDIX D

BEACH SEINE CATCH DATA 1984

BEACH SEINE CATCH DATA

This appendix provides tables of beach seine catches of each species on each transect broken down by cruise and station. Data presented are means of the replicate taken at that station, transect, and cruise and are based on catch per set. Approximate area sampled by each beach seine was 900 m^2. Frequency of occurrence of (number of sets containing) each species is also provided along with a summary for each transect in each cruise.

For identification a four-digit code is placed at the top of each column. The first digit identifies the cruise, the second the transect number and the last two digits are the station number.

Data from Cruises 1, 2, and 3 are contained in Tables D-1, D-2, and D-3, respectively.

APPENDIX TABLE D-1

BEACH SEINE CATCH DATA SUMMARY FOR CRUISE 1

Transect 2

Common Species Name	Station 6 1206 Freq	Mean Abund	Mean Weight	Transect Summary Freq	Mean Abund	Mean Weight
CHUM SALMON Juv	0.0	0.0	0.0	0.0	0.0	0.0
CHUM SALMON Adult	0.0	0.0	0.0	0.0	0.0	0.0
COHO SALMON Juv	0.0	0.0	0.0	0.0	0.0	0.0
SOCKEYE SALMON Juv	0.0	0.0	0.0	0.0	0.0	0.0
SOCKEYE SALMON Adult	0.0	0.0	0.0	0.0	0.0	0.0
RAINBOW SMELT	2.0	14.0	425.0	1.0	14.0	425.0
EULACHON	0.0	0.0	0.0	0.0	0.0	0.0
PACIFIC COD	0.0	0.0	0.0	0.0	0.0	0.0
KELP GREENLING	0.0	0.0	0.0	0.0	0.0	0.0
WHITESPOTTED GREENLING	0.0	0.0	0.0	0.0	0.0	0.0
SCULPIN UNID	0.0	0.0	0.0	0.0	0.0	0.0
THREADED SCULPIN (A)	1.0	0.5	2.5	.0	0.5	2.5
STAGHORN SCULPIN	0.0	0.0	0.0	0.0	0.0	0.0
PLAIN SCULPIN	0.0	0.0	0.0	0.0	0.0	0.0
TUBENOSE POACHER	0.0	0.0	0.0	0.0	0.0	0.0
PACIFIC SANDLANCE	0.0	0.0	0.0	0.0	0.0	0.0
ROCK SOLE	0.0	0.0	0.0	0.0	0.0	0.0
YELLOWFIN SOLE	0.0	0.0	0.0	0.0	0.0	0.0
LONGHEAD DAB	0.0	0.0	0.0	0.0	0.0	0.0
ARCTIC FLOUNDER	2.0	1.0	45.0	1.0	1.0	45.0
STARRY FLOUNDER	2.0	25.0	850.0	1.0	25.0	850.0
Number of Species	4.0			4.0		
Mean Abundance		40.5			40.5	
Mean Weight (g)			1322.5			1322.5
Number of Replicates			2.0			2.0

Transect 3

Common Species Name	Station 3 1305 Freq	Mean Abund	Mean Weight	Transect Summary Freq	Mean Abund	Mean Weight
CHUM SALMON Juv	1.0	1.5	4.5	1.0	1.5	4.0
CHUM SALMON Adult	0.0	0.0	0.0	0.0	0.0	0.0
COHO SALMON Juv	0.0	0.0	0.0	0.0	0.0	0.0
SOCKEYE SALMON Juv	0.0	0.0	0.0	0.0	0.0	0.0
SOCKEYE SALMON Adult	0.0	0.0	0.0	0.0	0.0	0.0
RAINBOW SMELT	0.0	0.0	0.0	0.0	0.0	0.0
EULACHON	0.0	0.0	0.0	0.0	0.0	0.0
PACIFIC COD	0.0	0.0	0.0	0.0	0.0	0.0
KELP GREENLING	0.0	0.0	0.0	0.0	0.0	0.0
WHITESPOTTED GREENLING	0.0	0.0	0.0	0.0	0.0	0.0
SCULPIN UNID	0.0	0.0	0.0	0.0	0.0	0.0
THREADED SCULPIN (A)	0.0	0.0	0.0	0.0	0.0	0.0
STAGHORN SCULPIN	0.0	0.0	0.0	0.0	0.0	0.0
PLAIN SCULPIN	0.0	0.0	0.0	0.0	0.0	0.0
TUBENOSE POACHER	0.0	0.0	0.0	0.0	0.0	0.0
PACIFIC SANDLANCE	2.0	985.5	2381.0	[illegible]	9[illegible]5	2381.0
ROCK SOLE	0.0	0.0	0.0	0.0	0.0	0.0
YELLOWFIN SOLE	0.0	0.0	0.0	0.0	0.0	0.0
LONGHEAD DAB	0.0	0.0	0.0	0.0	0.0	0.0
ARCTIC FLOUNDER	0.0	0.0	0.0	0.0	0.0	0.0
STARRY FLOUNDER	0.0	0.0	0.	0	.0	0.
Number of Species	2.0			2.0		
Mean Abundance		987.0			987.0	
Mean Weight (g)			2385.5			2385.5
Number of Replicates			2.0			2.0

APPENDIX TABLE D-1 (cont.)

Transect 4

Common Species Name	1405 Freq	Station 5 Mean Abund	Mean Weight	1406 Freq	Station 6 Mean Abund	Mean Weight	1408 Freq	Station 8 Mean Abund	Mean Weight	1409 Freq	Station 9 Mean Abund	Mean Weight
CHUM SALMON Juv	0.0	0.0	0.0	1.0	1*0	6.0	0.0	0.0	0.0	0.0	0.0	0.0
CHUM SALMON Adult	0.0	0.0	0*0	0.0	0*0	0.0	0.0	0*0	0.0	1.0	8.5	32800.0
COHO SALMON Juv	0.0	0.0	0.0	0.0	0.0	0.0	1.0	3.5	91.0	1*O	1.5	42.5
SOCKEYE SALMON Juv	0.0	0.0	0.0	1.0	4*0	32.0	0.0	0.0	0.0	1.0	0.5	8.5
SOCKEYE SALMON Adult	0.0	0.0	0.0	1.0	0.5	1230.0	0.0	0.0	0.0	0.0	0.0	0.0
RAINBOW SMELT	2.0	11.0	160.0	0.0	0*0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
EULACHON	2.0	5.5	125*O	0*0	0.0	0.0	1.0	0.5	35.0	1.0	2.5	112.5
PACIFIC COD	2.0	1*5	2s.0	0*0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0*0
KELP GREENLING	1.0	0.5	65.0	0.0	0.0	0.0	0*0	0.0	0.0	0.0	0.0	0.0
WHITESPOTTED GREENLING	2*0	1.0	26.5	0.0	0.0	0,0	0*0	0*0	0.0	0.0	0.0	0.0
SCULPIN UNID	0.0	0.0	O*O	0*0	0.0	0.0	1.0	0.5	100.0	0.0	0.0	0.0
THREADED SCULPIN (A)	0*0	0.0	0.0	0*0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
STAGHORN SCULPIN	1.0	1.0	175.0	1.0	0.5	200.0	0.0	0*0	0.0	0.0	0.0	0.0
PLAIN SCULPIN	0*0	0.0	0.0	0.0	0.0	O*O	1.0	1.5	1000.0	1.0	0.5	500.0
TUBENOSE POACHER	2.0	3.0	19.5	0.0	0.0	O*O	0.0	0*0	0.0	0.0	0.0	0.0
PACIFIC SANDLANCE	0*0	0.0	0.0	2*0	906.5	1525.0	1.0	14080.0.	44000.0	1.0	335.0	1050.0
ROCK SOLE	0.0	0.0	0.0	2.0	1.0	50.0	0.0	0.0	0.0	0.0	0.0	0.0
YELLOWFIN SOLE	2*0	2.0	80.0	0.0	0.0	0.0	1.0	2.5	500.0	0.0	0.0	0.0
LONGHEAD DAB	0.0	0.0	O*O	1.0	0.5	20.0	O*O	0.0	0.0	0.0	0.0	0.0
ARCTIC FLOUNDER	0.0	0*0	0.0	0.0	0.0	0.0	0.0	0.0	0,0	0.0	0.0	0.0
STARRY FLOUNDER	0.0	0.0	0.0	1.0	0.5	125*O	0.0	0.0	0.0	0,0	0.0	0.0
Number of Species	8.0			8.0			6.0			6.0		
Mean Abundance		25.5			914.5			14088.5			348.5	
Mean Weight (g)			676.0			3208.0			45726.0			34513.5
Number of Replicates			2.0			2.0			2.0			2.0

Transect 4 (cont.)

Common Species Name	Transect Summary Freq	Mean Abund	Mean Weight
CHUM SALMON Juv	1.0	0.3	1.5
CHUM SALMON Adult	1.0	2.1	8200.0
COHO SALMON Juv	2.0	1.3	33.4
SOCKEYE SALMON Juv	2.0	1*1	10.1
SOCKEYE SALMON Adult	1.0	0*1	312.5
RAINBOW SMELT	1.0	2.8	40.0
EULACHON	3.0	2.1	68.1
PACIFIC COD	1.0	0.4	6.3
KELP GREENLING	1.0	0.1	16.3
WHITESPOTTED GREENLING	1.0	0.3	6.6
SCULPIN UNID	1.0	0.1	25.0
THREADED SCULPIN (A)	0.0	0.0	0.0
STAGHORN SCULPIN	2.0	0.4	93.s
PLAIN SCULPIN	2.0	0.5	375.0
TUBENOSE POACHER	1.0	0.8	4.9
PACIFIC SANDLANCE	3.0	3s30 .4	11643.8
ROCK SOLE	1.0	0*3	12.5
YELLOWFIN SOLE	2.0	41.1	145.0
LONGHEAD DAB	1.0	0.1	5.0
ARCTIC FLOUNDER	0.0	0.0	0.0
STARRY FLOUNDER	1.0	0.1	31.3
Number of Species	19.0		
Mean Abundance		3844.3	
Mean Weight (q)			21030.9
Number of Replicates			8.0

APPENDIX TABLE D-2

BEACH SEINE CATCH DATA SUMMARY FOR CRUISE 2

Transect 0

Common Species Name	Station 6: 2006 Freq	Station 6: Mean Abund	Station 6: Mean Weight	Station 7: 2007 Freq	Station 7: Mean Abund	Station 7: Mean Weight	Transect Summary: Freq	Transect Summary: Mean Abund	Transect Summary: Mean Weight
CHUM SALMON Juv	0.0	0.0	0.0	2.0	1.5	29.0	1.0	0.8	14.5
COHO SALMON Juv	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SOCKEYE SALMON Juv	1.0	2.0	7.0	1.0	1.0	4.0	2.0	1.5	5.5
CHINOOK SALMON Juv	0.0	0.0	0.0	1.0	1.0	10.5	1.0	0.5	5.3
DOLLY VARDEN Adult	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SMELT UNID	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SURF SMELT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
POND SMELT	2.0	2.0	20.0	2.0	11.5	137.5	2.0	6.8	78.8
RAINBOW SMELT	2.0	77.5	850.0	2.0	67.5	712.5	2.0	72.5	781.3
PACIFIC COD	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NINE-SPINE STICKLEBACK	1.0	0.5	0.5	2.0	1.0	1.0	2.0	0.8	0.8
WHITESPOTTED GREENLING	2.0	0.0	55.0	0.0	0.0	0.0	1.0	3.5	27.5
SCULPIN UNID	1.0	7.5	10.0	0.0	0.0	0.0	1.0	0.3	5.0
CRESTED SCULPIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
STAGHORN SCULPIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
STURGEON POACHER	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BERING POACHER	1.0	0.0	100.0	0.0	0.0	0.0	1.0	4.5	50.0
PACIFIC SANDFISH	0.0	9.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SNAKE PRICKLEBACK	0.0	0.0	0.0	2.0	2.0	55.0	1.0	1.0	27.5
PACIFIC SANDLANCE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ROCK SOLE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
YELLOWFIN SOLE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LONGHEAD DAB	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ARCTIC FLOUNDER	2.0	0.0	183.5	1.0	1.0	35.0	2.0	1.3	109.3
STARRY FLOUNDER	2.0	11.5	345.0	2.0	5.0	42.5	2.0	1.5	193.8
ALASKA PLAICE	0.0	5.5	0.0	0.0	0.5	0.0	0.0	0.0	0.0
Number of Species	9.0			9.0			12.0		
Mean Abundance		115.5			92.0			103.3	
Mean Weight (g)			571.0			1027.0			1299.0
Number of Replicates			2.0			2.0			4.0

APPENDIX TABLE D-2 (cont.)

Transect 1

Common Species Name	Station 5 2105 Freq	Station 5 Mean Abund	Station 5 Mean Weight	Transect Summary Freq	Transect Summary Mean Abund	Transect Summary Mean Weight
CHUM SALMON Juv	0.0	0.0	0.0	0.0	0.0	0.0
COHO SALMON Juv	0.0	0.0	0.0	0.0	0.0	0.0
SOCKEYE SALMON Juv	0.0	0.0	0.0	0.0	0.0	0.0
CHINOOK SALMON Juv	0.0	0.0	0.0	0.0	0.0	0.0
DOLLY VARDEN Adult	0.0	0.0	0.0	0.0	0.0	0.0
SMELT UNID	0.0	0.0	0.0	0.0	0.0	0.0
SURF SMELT	0.0	0.0	0.0	0.0	0.0	0.0
POND SMELT	0.0	0.0	0.0	0.0	0.0	0.0
RAINBOW SMELT	2.0	60.5	910.0	1.0	60.5	910.0
PACIFIC COD	0.0	0.0	0.0	0.0	0.0	0.0
NINE-SPINE STICKLEBACK	0.0	0.0	0.0	0.0	0.0	0.0
WHITESPOTTED GREENLING	2.0	4.0	85.0	1.0	4.0	85.0
SCULPIN UNID	1.0	0.5	2.5	1.0	0.5	2.5
CRESTED SCULPIN	0.0	0.0	0.0	0.0	0.0	0.0
STAGHORN SCULPIN	0.0	0.0	0.0	0.0	0.0	0.0
STURGEON POACHER	1.0	0.5	2.5	1.0	0.5	2.5
BERING POACHER	0.0	0.0	0.0	0.0	0.0	0.0
PACIFIC SANDFISH	0.0	0.0	0.0	0.0	0.0	0.0
SNAKE PRICKLEBACK	0.0	0.0	0.0	0.0	0.0	0.0
PACIFIC SANDLANCE	0.0	0.0	0.0	0.0	0.0	0.0
ROCK SOLE	0.0	0.0	0.0	1.0	0.0	0.0
YELLOWFIN SOLE	2.0	5.0	145.0	1.0	5.0	145.0
LONGHEAD DAB	1.0	0.5	5.0	0.0	0.5	5.0
ARCTIC FLOUNDER	0.0	0.0	0.0	0.0	0.0	0.0
STARRY FLOUNDER	1.0	1.0	40.0	1.0	1.0	40.0
ALASKA PLAICE	2.0	2.0	16.0	1.0	2.0	16.0
Number of Species	8.0			8.0		
Mean Abundance		74.0			74.0	
Mean Weight (g)			1206.0			1206.0
Number of Replicates			2.0			2.0

APPENDIX TABLE D-2 (cont.)

Transect 4

Common Species Name	Station 5 2405 Freq	Station 5 Mean Abund	Station 5 Mean Weight	Station 6 2406 Freq	Station 6 Mean Abund	Station 6 Mean Weight	Transect Summary Freq	Transect Summary Mean Abund	Transect Summary Mean Weight
CHUM SALMON Juv	0.0	0.0	0.0	1.0	2.3	5.0	1.0	1.1	2.5
COHO SALMON Juv	0.0	0*0	0*0	0.0	0,0	0.0	0.0	0.0	0.0
SOCKEYE SALMON Juv	0.0	0*0	0.0	1*0	0.5	24.8	1.0	0.3	12.4
CHINOOK SALMON Juv	0.0	0.0	0.0	0.0	0*0	0.0	0.0	0.0	0*0
DOLLY VARDEN Adult	1.0	0.3	86.3	0.0	0*0	0.0	1.0	0.1	43.1
SMELT UNID	0.0	0*0	0.0	1.0	1.3	0.3	1.0	0.6	0.1
SURF SMELT	0.0	0.0	0.0	0.0	0.0	0*0	0.0	0.0	0.0
POND SMELT	0.0	0.0	0.0	0.0	0*0	0.0	0.0	0.0	0.0
RAINBOW SMELT	1.0	0.3	6*3	0.0	0*0	0.0	1.0	0.1	3.1
PACIFIC COO	2.0	1.5	6.5	4.0	1.8	4.5	2*0	1.6	5.5
NINE-SPINE STICKLEBACK	0.0	0*0	0*0	0.0	0.0	0.0	0.0	0.0	0.0
WHITESPOTTED GREENLING	1.0	003	3.0	0*0	0*0	0.0	1.0	0.1	1.5
SCULPIN UNID	0.0	0*0	0.0	0*0	0*0	0*0	0*0	0*0	0*0
CRESTED SCULPIN	0.0	0.0	0.0	0.0	0.0	0*0	0.0	0.0	0.0
STAGHORN SCULPIN	2.0	0.5	213.3	1*0	0*3	124.0	2.0	0.4	168.6
STURGEON POACHER	0.0	0*0	0*0	0.0	0.0	0.0	0,0	0*0	0.0
BERING POACHER	0.0	0.0	0.0	0.0	0.0	0*0	0.0	0.0	0.0
PACIFIC SANDFISH	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SNAKE PRICKLEBACK	0.0	0.0	0.0	0.0	0.0	0.0	0*0	0.0	0.0
PACIFIC SANDLANCE	1*0	15.0	31,3	4.0	9.5	22.5	2.0	12*3	26.9
ROCK SOLE	0.0	0.0	0.0	1*0	0.5	17.0	1.0	0.3	8.5
YELLOWFIN SOLE	0.0	0*0	0*0	1.0	0.3	0.5	1.0	0.1	0*3
LONGHEAD DAB	0*0	0.0	0.0	0.0	0*0	0.0	0.0	0.0	0.0
ARCTIC FLOUNDER	0*0	0.0	0*0	0*0	0.0	0.0	0.0	0.0	0.0
STARRY FLOUNDER	2.0	0.5	85.0	0*0	0.0	0.0	1.0	0.3	42.5
ALASKA PLAICE	0.0	0*0	0.0	0.0	0.0	0.0	0,0	0.0	0.0
Number of Species	7*0			8.0			12.0		
Hean Abundance		18.3			16.3			17.3	
Mean Weight (a)			431.5			198.5			315*0
Number of Replicates			4.0			4.0			8.0

APPENDIX TABLE D-2 (cont.)

Transect 6 Common Species Name	Station 5 2605 Freq	Mean Abund	Mean Weight	Station 6 2606 Freq	Mean Abund	Mean Weight	Station 10 2610 Freq	Mean Abund	Mean Weight	Station 11 2611 Freq	Mean Abund	Mean Weight
CHUM SALMON Juv	1.0	2.5	5.0	0.0	0,0	0.0	0.0	0.0	0.0	O*()	0.0	0.0
COHO SALMON Juv	1.0	1*0	13.0	0.0	0.0	0.0	0*0	0.0	0.0	1.0	0.5	13.5
SOCKEYE SALMON Juv	2.0	7*0	43.5	1.0	0*3	4.7	1.0	0.3	2.3	0.0	0.0	0*0
CHINOOK SALMON Juv	0.0	0*0	0.0	0.0	0.0	0.0	0*0	0.0	0*0	0*0	0.0	0*0
DOLLY VARDEN Adult	1.0	0.5	65.0	0*0	0*0	0.0	1.0	0.7	80.0	0.0	0.0	0.0
SMELT UNID	0*0	0*0	0*0	0.0	0*0	0,0	0.0	0.0	0.0	1.0	4.5	2.5
SURF SMELT	1*0	0.5	10.0	0.0	0.0	0.0	0.0	0*0	0.0	1.0	1*0	15.0
POND SMELT	0.0	0.0	0.0	0.0	0*0	0*0	0*0	0.0	0.0	0*0	0.0	0.0
RAINBOW SMELT	0.0	0*0	0.0	1*0	20.0	1166.7	1.0	2.0	146.7	0.0	0*0	0.0
PACIFIC COD	0.0	0*0	000	0.0	0.0	0*0	2.0	1.0	8.3	1.0	0.5	3.5
NINE-SPINE STICKLEBACK	0.0	0.0	0.0	0.0	0.0	0*0	0.0	0*0	0*0	0.0	0,0	0*0
WHITESPOTTED GREENLING	0.0	0*0	0.0	0*0	0.0	0.0	0.0	0.0	0*0	0*0	0*0	0,0
SCULPIN UNID	0*0	0.0	0.0	0*0	0*0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CRESTED SCULPIN	0*0	0.0	0*0	0.0	0.0	0.0	1*0	0.3	5.0	0*0	0.0	0.0
STAGHORN SCULPIN	0.0	0.0	0.0	3*0	40.0	2315.0	3*0	7*7	720.0	1.0	0.5	55.0
STURGEON POACHER	0.0	0.0	0.0	0*0	0.0	0.0	0.0	0.0	0*0	0.0	0.0	0.0
BERING POACHER	0*0	0.0	0*0	0*0	0.0	0.0	0*0	0.0	0.0	0*0	0.0	0*0
PACIFIC SANDFISH	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0,7	30.0	0.0	0*0	0.0
SNAKE PRICKLEBACK	0.0	0*0	0.0	0.0	0.0	0*0	0.0	0.0	0.0	0*0	0.0	0.0
PACIFIC SANDLANCE	2*0	71*0	75.0	1*0	0*3	3.3	2*0	66,3	158.0	2.0	45.0	140.0
ROCK SOLE	0*0	0.0	0.0	1.0	0*7	11*7	0.0	0.0	0.0	0.0	0.0	0.0
YELLOWFIN SOLE	0.0	0*0	0*0	0.0	0*0	0.0	0.0	0.0	0*0	0.0	0*0	0*0
LONGHEAD DAB	0.0	0.0	0.0	0.0	0*0	0.0	0.0	0*0	0*0	0.0	0.0	0.0
ARCTIC FLOUNDER	0.0	0*0	0.0	0*0	0.0	0*0	0.0	0.0	0.0	0.0	0.0	0.0
STARRY FLOUNDER	0*0	0*0	0.0	0*0	0*0	0*0	0*0	0.0	0.0	0.0	0.0	0*0
ALASKA PLAICE	0*0	0.0	0.0	3*0	3.0	83.7	3*0	1.3	71.7	0*0	0.0	0.0
Number of Species	6.0			6.0			9.0			6.0		
Mean Abundance		82.5			64.3			80.3			52.0	
Mean Weight (g)			211.5			3585.0			1222.0			229.5
Number of Replicates			2.0			3.0			3.0			2.0

APPENDIX TABLE 0-2 (cont.)

Transect 6 (cent)

Common Species Name	Transect Summary Freq	Mean Abund	Mean Weight
CHUM SALMON Juv	1.0	0.5	1.0
COHO SALMON Juv	2.0	0*3	5.3
SOCKEYE SALMON Juv	3.0	1.6	10.8
CHINOOK SALMON Juv	0*0	0.0	0.0
GOLLY VARDEN Adult	2.0	0.3	37*0
SMELT UNID	1.0	0*9	0.5
SURF SMELT	2.0	0.3	5.0
POND SMELT	0.0	0*0	0.0
RAINBOW SMELT	2.0	6.6	394.0
PACIFIC COD	2.0	0.4	3.2
NINE-SPINE STICKLEBACK	0.0	0.0	0.0
WHITESPOTTED GREENLING	0.0	0*0	0.0
SCULPIN UNID	0*0	000	0*0
CRESTED SCULPIN	1.0	0.1	1.5
STAGHORN SCULPIN	3*0	14.4	921.5
STURGEON POACHER	0.0	0.0	0.0
BERING POACHER	0*0	0.0	0.0
PACIFIC SANDFISH	1.0	0*2	9.0
SNAKE PRICKLEBACK	0.0	0*0	0.0
PACIFIC SANDLANCE	4.0	43.2	91*4
ROCK SOLE	100	0*2	3.5
YELLOWFIN SOLE	0.0	0*0	0*0
LONGHEAD DAB	0*0	0*0	0.0
ARCTIC FLOUNDER	0.0	0.0	0*0
STARRY FLOUNDER	0.0	0.0	0.0
ALASKA PLAICE	2*0	1.3	46*6
Number of Species	14.0		
Mean Abundance		70.3	
Mean Weight (g)			1530.3
Number of Replicates			10.0

APPENDIX TABLE D-3

BEACH SEINE CATCH DATA MM FOR CRUISE 3

Transect 3

Common Species Name	Station 5 3305 Freq	Station 5 Mean Abund	Station 5 Mean Weight	Transect Summary Freq	Transect Summary Mean Abund	Transect Summary Mean Weight
PACIFIC HERRING	0.0	0.0	0.0	0.0	0.0	0.0
COHO SALMON Juv	0.0	0.0	0.0	0.0	0.0	0.0
COHO SALMON Adult	1.0	0.5	2270.0	1.0	0.5	2270.0
SURF SMELT	0.0	0.0	0.0	0.0	0.0	0.0
CAPELIN	0.0	0.0	0.0	0.0	0.0	0.0
RAINBOW SMELT	0.0	0.0	0.0	0.0	0.0	0.0
PACIFIC COD	0.0	0.0	0.0	0.0	0.0	0.0
THREESPINE STICKLEBACK	0.0	0.0	0.0	0.0	0.0	0.0
WHITESPOTTED GREENLING	1.0	0.5	30.0	1.0	0.5	30.0
THREADED SCULPIN (A)	0.0	0.0	0.0	0.0	0.0	0.0
STAGHORN SCULPIN	1.0	0.5	50.0	1.0	0.5	50.0
GREAT SCULPIN	0.0	0.0	0.0	0.0	0.0	0.0
BERING POACHER	1.0	0.5	10.0	1.0	0.5	10.0
TUBENOSE POACHER	0.0	0.0	0.0	0.0	0.0	0.0
PACIFIC SANDFISH	1.0	0.5	30.0	1.0	0.5	30.0
PACIFIC SANDLANCE	0.0	0.0	0.0	0.0	0.0	0.0
ROCK SOLE	0.0	0.0	0.0	0.0	0.0	0.0
YELLOWFIN SOLE	0.0	0.0	0.0	0.0	0.0	0.0
STARRY FLOUNDER	1.0	2.0	350.0	1.0	2.0	350.0
ALASKA PLAICE	1.0	0.5	2.5	1.0	0.5	2.5
PACIFIC HALIBUT	0.0	0.0	0.0	0.0	0.0	0.0
Number of Species	7.0			7.0		
Mean Abundance		5.0			5.0	
Mean Weight (g)			2742.5			2742.5
Number of Replicates			2.0			2.0

Transect 4

Common Species Name	Station 5 3405 Freq	Station 5 Mean Abund	Station 5 Mean Weight	Station 6 3406 Freq	Station 6 Mean Abund	Station 6 Mean Weight	Station 9 3409 Freq	Station 9 Mean Abund	Station 9 Mean Weight	Transect Summary Freq	Transect Summary Mean Abund	Transect Summary Mean Weight
PACIFIC HERRING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
COHO SALMON Juv	2.0	1.0	15.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.3	4.3
COHO SALMON Adult	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SURF SMELT	0.0	0.0	0.0	1.0	1.0	31.7	0.0	0.0	0.0	1.0	0.4	13.6
CAPELIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
RAINBOW SMELT	2.0	209.0	2525.0	0.0	0.0	0.0	1.0	0.5	2.5	2.0	59.9	722.1
PACIFIC COD	2.0	20.0	97.5	2.0	[illegible]	14.0	2.0	4.0	4.5	3.0	8.7	35.1
THREESPINE STICKLEBACK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
WHITESPOTTED GREENLING	2.0	4.0	107.5	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.1	30.7
THREADED SCULPIN (A)	0.0	0.0	0.0	0.0	0.0	0.0	2.0	3.0	37.5	1.0	0.9	10.7
STAGHORN SCULPIN	0.0	0.0	0.0	0.0	0.3	10.0	0.0	0.0	0.0	1.0	0.1	4.3
GREAT SCULPIN	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.5	500.0	1.0	0.1	142.9
BERING POACHER	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TUBENOSE POACHER	2.0	2.0	5.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.6	1.4
PACIFIC SANDFISH	1.0	1.0	25.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.3	7.1
PACIFIC SANDLANCE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ROCK SOLE	0.0	0.0	0.0	0.0	0.3	11.7	2.0	8.0	95.0	2.0	2.4	32.1
YELLOWFIN SOLE	2.0	1.5	75.0	0.0	0.0	0.0	2.0	25.5	4500.0	2.0	7.7	1307.1
STARRY FLOUNDER	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ALASKA PLAICE	0.0	0.0	0.0	0.0	0.3	8.3	2.0	10.5	310.0	2.0	3.1	92.1
PACIFIC HALIBUT	0.0	0.0	0.0	[illegible]	0.3	23.3	0.0	0.0	0.0	1.0	0.1	10.0
Number of Species	7.0			6.0			7.0			14.0		
Mean Abundance		238.5			6.7			52.0			85.9	
Mean Weight (g)			2850.0			99.0			5449.5			2413.7
Number of Replicates			2.0			3.0			2.0			7.0

APPENDIX TABLE D-3 (cont.)

Transect 6

Common Species Name	Station 5 3605 Freq	Station 5 Mean Abund	Station 5 Weight	Station 6 3606 Freq	Station 6 Mean Abund	Station 6 Mean Weight	Transect Summary Freq	Transect Summary Mean Abund	Transect Summary Mean Weight
PACIFIC HERRING	1.0	1.5	2.0	0.0	0.0	0.0	1.0	0.6	0.8
COHO SALMON Juv	2*O	5*O	109.5	1.0	0.7	8.3	2.0	2.4	48.8
COHO SALMON Adult	0.0	0.0	0*O	0.0	0*O	0.0	0.0	0.0	0*O
SURF SMELT	2.0	69,5	357.5	3*O	23.7	1250.0	2*O	42.0	993.0
CAPELIN	0.0	0.0	0*O	1*O	0.3	1.7	1.0	0.2	1*O
RAINBOW SMELT	0.0	0.0	0.0	1.0	0.3	10*O	1.0	0*2	6*O
PACIFIC COD	0*O	0*O	0.0	1*O	0*7	1.7	1*O	0.4	1.0
THREESPINE STICKLEBACK	2.0	2*O	2.0	0.0	0.0	0.0	1.0	0.8	0.8
WHITESPOTTED GREENLING	0*O	0.0	0*O	1.0	0*3	3.3	1.0	0.2	2.0
THREADED SCULPIN (A)	0.0	0.0	0.0	0.0	0*O	0.0	0.0	0.0	0.0
STAGHORN SCULPIN	1.0	0.5	40.0	2.0	2*O	141.7	2.0	1.4	101.0
GREAT SCULPIN	0.0	0,0	0*O	0.0	0*O	0.0	().0	0.0	0.0
BERING POACHER	0 . 0	0.0	0.0	0*O	0.0	0.0	0.0	0*O	0*O
TUBENOSE POACHER	0,0	0.0	0.0	2.0	1*3	1*7	1.0	0.8	1.0
PACIFIC SANDFISH	0.0	0*O	0.0	0*O	0.0	0*O	0.0	0.0	000
PACIFIC SANDLANCE	0*O	0.0	0.0	3,0	11.0	?.3	1*O	6*6	S.6
ROCK SOLE	1.0	1.0	7.5	2.0	1.3	14*3	2.0	1*2	11.6
YELLOWFIN SOLE	0.0	0,0	0.0	0.0	0.0	0*O	0*O	0*O	0.0
STARRY FLOUNDER	0.0	0*O	0*O	2*O	1.7	2.7	1*O	1*O	1.6
ALASKA PLAICE	2.0	1.0	13.5	3*O	4.0	70.0	2*O	2.0	47.4
PACIFIC HALIBUT	0.0	0.0	0.0	0*O	O*O	0*O	0*O	0*O	0.0
Number of Species	7*O			12.0			14*O		
Mean Abundance		80.5			47.3			60.6	
Mean Weight (q)			532.0			1514.7			1121.6
Number of Replicates			2.0			3.0			5*O

APPENDIX E

OTTER TRAWL CATCH DATA 1984

OTTER TRAWL CATCH DATA

This appendix provides tables of otter trawl catches of each species on each transect broken down by cruise and station. Data presented are means of the replicate taken at that station, transect, and cruise and are based on a 10-minute bottom time. The approximate area swept, based on an assumed actual net opening of 5.49 m (18 feet) and an average speed over the bottom of 1 m/s (2 knots), is about 3300 m^2. Frequency of occurrence (number of sets containing) each species is also provided along with a summary for each transect in each cruise.

For identification a four-digit code is placed at the top of each column. The first digit identifies the cruise, the second the transect number and the last two digits are the station number.

Data from Cruises 1, 2, and 3 are contained in Tables E-1, E-2, and E-3, respectively.

APPENDIX TABLE E-1

OTTER TRAWL CATCH DA[illegible] SUMMARY FOR CRUISE 1

Transect 2

Common Species Name	Station 2 1202 Freq	Station 2 Mean Abund	Station 2 Mean Weight	Station 3 1203 Freq	Station 3 Mean Abund	Station 3 Mean Weight	Station 4 1204 Freq	Station 4 Mean Abund	Station 4 Mean Weight	Transect Summary Freq	Transect Summary Mean Abund	Transect Summary Mean Weight
empty haul	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
RAINBOW SMELT	0.0	0.0	0.0	1.0	0.5	25.0	0.0	0.0	0.0	1.0	0.2	8.3
PACIFIC COD	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
WALLEYE POLLOCK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
WHITESPOTTED GREENLI[illegible]G	2.0	1.5	97.5	1.0	1.5	75.0	2.0	[illegible].0	27.5	3.0	1.3	66.7
SCULPIN UNID	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
THREADED SCULPIN (A)	2.0	71.0	1250.0	2.0	15.0	550.0	0.0	0.0	0.0	2.0	28.7	600.0
STAGHORN SCULPIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BRIGHTBELLY SCULPIN (B)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PLAIN SCULPIN	1.0	0.5	225.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.2	75.0
TIDEPOOL SCULPIN (B?)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
RIBBED SCULPIN	2.0	2.0	22.5	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.7	7.5
STURGEON POACHER	1.0	0.5	2.5	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.2	0.8
BERING POACHER	0.0	0.0	0.0	2.0	32.0	600.0	2.0	4.5	90.0	2.0	12.2	230.0
TUBENOSE POACHER	2.0	4.0	18.5	2.0	4.5	27.5	1.0	1.5	5.0	3.0	3.3	17.0
PACIFIC SANDFISH	0.0	0.0	0.0	1.0	0.5	15.0	0.0	0.0	0.0	1.0	0.2	5.0
SNAKE PRICKLEBACK	0.0	0.0	0.0	2.0	2.5	117.5	0.0	0.0	0.0	1.0	0.8	39.2
CRESCENT GUNNEL	1.0	0.5	5.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.2	1.7
PACIFIC SANDLANCE	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.5	1.5	1.0	0.2	0.5
FLATHEAD SOLE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BUTTER SOLE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ROCK SOLE	2.0	23.0	265.0	2.0	26.0	70.0	2.0	54.0	192.5	3.0	34.3	175.8
YELLOWFIN SOLE	2.0	58.0	575.0	2.0	76.0	3900.0	2.0	77.0	1400.0	3.0	70.3	1958.3
LONGHEAD DAB	0.0	0.0	0.0	2.0	25.5	975.0	1.0	3.0	90.0	2.0	9.5	355.0
STARRY FLOUNDER	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ALASKA PLAICE	0.0	0.0	0.0	2.0	36.0	1375.0	2.0	32.5	350.0	2.0	22.8	575.0
PACIFIC HALIBUT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Number of Species	9.0			11.0			8.0			16.0		
Mean Abundance		161.0			220.0			174.0			185.0	
Mean Weight (g)			2461.0			7730.0			2156.5			41[illegible]5.8
Number of Replicates			2.0			2.0			2.0			6.0

APPENDIX TABLE E-1 (cont.

Transect 3

Common Species Name	Station 2 1302 Freq	Station 2 Mean Abund	Station 2 Mean Weight	Station 3 1303 Freq	Station 3 Mean Abund	Station 3 Mean Weight	Station 4 1304 Freq	Station 4 Mean Abund	Station 4 Mean Weight	Transect Summary Freq	Transect Summary Mean Abund	Transect Summary Mean Weight
empty haul	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
RAINBOW SMELT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PACIFIC COD	3.0	3.0	265.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	88.3
WALLEYE POLLOCK	2.0	2.5	75.0	1.0	0.5	7.5	0.0	0.0	0.0	2.0	1.0	27.5
WHITESPOTTED GREENLING	1.0	2.5	100.0	1.0	4.0	100.0	0.0	0.0	0.0	2.0	2.2	66.7
SCULPIN UNID	0.0	0.0	0.0	2.0	1.5	35.0	1.0	0.5	10.0	2.0	0.7	15.0
THREADED SCULPIN (A)	1.0	2.5	65.0	2.0	3.0	100.0	0.0	0.0	0.0	2.0	1.8	55.0
STAGHORN SCULPIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BRIGHTBELLY SCULPIN (B)	0.0	0.0	0.0	2.0	1.5	20.0	0.0	0.0	0.0	1.0	0.5	6.7
PLAIN SCULPIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TIDEPOOL SCULPIN (B?)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
RIBBED SCULPIN	0.0	0.0	0.0	1.0	0.5	5.0	0.0	0.0	0.0	1.0	0.2	1.7
STURGEON POACHER	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BERING POACHER	0.0	0.0	0.0	2.0	4.0	77.5	2.0	19.5	325.0	2.0	7.8	134.2
TUBENOSE POACHER	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PACIFIC SANDFISH	0.0	0.0	0.0	2.0	1.5	75.0	2.0	10.0	296.0	2.0	3.8	123.7
SNAKE PRICKLEBACK	0.0	0.0	0.0	2.0	2.5	75.0	2.0	2.0	65.0	2.0	1.5	46.7
CRESCENT GUNNEL	1.0	1.0	20.0	2.0	2.5	60.0	1.0	1.0	15.5	3.0	1.5	31.8
PACIFIC SANDLANCE	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	2.5	1.0	0.3	0.8
FLATHEAD SOLE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BUTTER SOLE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ROCK SOLE	2.0	18.0	1662.5	2.0	4.5	82.5	2.0	1.5	5.0	3.0	8.0	583.3
YELLOWFIN SOLE	2.0		2425.0	2.0	41.5	3175.0	2.0	293.0	15775.0	3.0	123.0	7125.0
LONGHEAD DAB	0.0	34.5	0.0	2.0	1.0	20.0	1.0	1.5	25.0	2.0	0.0	15.0
STARRY FLOUNDER	0.0	0.0	0.0	0.	0.0	0.0	1.0	1.5	1000.0	1.0	0.8	333.3
ALASKA PLAICE	0.0	0.0	0.0	2.0	1.0	3.0	2.0	9.0	65.0	2.0	3.5	22.7
PACIFIC HALIBUT	2.0	0.0	1251.5	1.0	0.5	40.0	0.0	0.0	0.0	2.0	0.3	430.5
	----1	- 1.5	-----	--	______	-----	----1	-__.0	-----	-----	--_.7	-----
Number of Species	8.0	----		15.0			11.0	--		18.0	--	
Mean Abundance		65.5			70.0			340.5			153.7	
Mean Weight (g)			5864.0			3875.5			17584.0			9107.8
Number of Replicates			2.0			2.0			2.0			6.0

APPENDIX TABLE =-1 (cont.)

Transect 4

Common Species Name	Station 2 1402 Freq	Station 2 Mean Abund	Station 2 Mean Weight	Station 3 1403 Freq	Station 3 Mean Abund	Station 3 Mean Weight	Station 4 1404 Freq	Station 4 Mean Abund	Station 4 Mean Weight	Station 7 1407 Freq	Station 7 Mean Abund	Station 7 Mean Weight
empty haul	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
RAINBOW SMELT	0.0	0.0	0.0	2.0	1.0	35.0	1.0	0.5	15.0	2.0	5.5	97.5
PACIFIC COD	2.0	3.0	142.5	1.0	1.0	20.0	1.0	0.5	15.0	1.0	0.5	5.0
WALLEYE POLLOCK	1.0	0.5	7.5	1.0	1.0	12.5	0.0	0.0	0.0	0.0	0.0	0.0
WHITESPOTTED GREENLING	0.0	0.0	0.0	2.0	1.0	50.0	2.0	6.5	300.0	2.0	2.0	95.0
SCULPIN UNID	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
THREADED SCULPIN (A)	1.0	0.5	7.5	2.0	6.5	90.0	2.0	19.5	495.0	2.0	13.5	350.0
STAGHORN SCULPIN	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.5	100.0	1.0	1.0	200.0
BRIGHTBELLY SCULPIN (B)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	12.5
PLAIN SCULPIN	0.0	0.0	0.0	0.	0.0	0.0	0.	0.0	0.0	1.0	[illegible]	100.0
TIDEPOOL SCULPIN (B?)	0	0.0	0.0	1.0	0.5	1.5	0.0	0.	0.0	0.	0.5	0.0
RIBBED SCULPIN	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.
STURGEON POACHER	0.0	0.0	0.0	1.0	0.5	2.5	0.0	0.0	0.0	0.0	0.0	0.0
BERING POACHER	2.0	3.0	162.5	1.0	4.0	25.0	1.0	1.[illegible]	9.0	1.0	0.0	25.0
TUBENOSE POACHER	0.0	0.0	0.0	1.0	0.5	2.5	2.0	1.[illegible]	4.0	0.0	1.0	0.0
PACIFIC SANDFISH	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SNAKE PRICKLEBACK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0	0.0	30.0
CRESCENT GUNNEL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0
PACIFIC SANDLANCE	1.0	1.0	5.0	1.0	1.0	15.0	0.0	0.0	0.0	0.0	0.0	0.0
FLATHEAD SOLE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BUTTER SOLE	1.0	0.5	250.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ROCK SOLE	2.0	110.	2375.0	2.	0.	925.0	2.0	41.[illegible]	450.0	2.0	0.0	90.0
YELLOWFIN SOLE	2.0	59.0	5305.0	2.0	168.0	7125.0	2.0	z14.[illegible]	7250.0	2.0	9.0	6800.0
LONGHEAD DAB	2.0	1.5	135.0	1.0	10.5	10.0	1.0	0.5	22.5	0.0	84.5	0.0
STARRY FLOUNDER	2.0	1.5	750.0	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ALASKA PLAICE	1.0	0.0	87.5	1.0	0.0	300.0	1.0	1.0	100.0	2.0	0.0	250.0
PACIFIC HALIBUT	1.0	0.5	2.5	0.0	3.0	0.0	2.0	4.0	192.5	0.0	5.0	0.0
Number of Species	12.0			14.0			z.0			12.0		
Mean Abundance		181.5			199.0			291.5			124.5	
Mean Weight (g)			9230.0			8614.0			8953.0			8055.0
Number of Replicates			2.0			2.0			2.0			2.0

APPENDIX TABLE E-1 (cont.)

Transect 4

Common Species Name	Station 10 1410 Freq	Station 10 Mean Abund	Station 10 Mean Weight	Station 11 1411 Freq	Station 11 Mean Abund	Station 11 Mean Weight	Transect Summary Freq	Transect Summary Mean Abund	Transect Summary Mean Weight
empty haul	O*O	O*O	0.0	0*0	0.0	O*O	0*0	0.0	0.0
RAINBOW SMELT	0.0	0.0	0.0	1.0	0.5	25.0	4.0	1.3	28.8
PACIFIC COD	0.0	0.0	0.0	0*0	0*0	0.0	4*0	0.8	30.4
WALLEYE POLLOCK	O*O	0.0	0.0	0*0	000	0.0	2*0	O*3	3.3
WHITESPOTTED GREENLING	0.0	0.0	0.0	1*0	0.5	22.5	4.0	1.7	77.9
SCULPIN UNID	O*O	0.0	O*O	0.0	0.0	0.0	0*0	0.0	0*0
THREADED SCULPIN (A)	1.0	0.5	3*5	1.0	0.5	17.5	6.0	6.8	160.6
STAGHORN SCULPIN	O*O	O*O	O*O	0.0	0.0	O*O	2*0	O*3	50.0
BRIGHTBELLY SCULPIN(B)	O*O	0.0	O*O	0*0	0.0	0.0	1*0	O*2	2.1
PLAIN SCULPIN	0,0	000	O*O	0.0	0*0	0.0	1.0	O*1	16,7
TIDEPOOL SCULPIN (B?)	0.0	O*O	0.0	0.0	0*0	O*O	1*0	O*1	0*3
RIBBED SCULPIN	0.0	0.0	0.0	0*0	0*0	000	0*0	0.0	0.0
STURGEON POACHER	0.0	0.0	0.0	0,0	0.0	0.0	1.0	0.1	0*4
BERING POACHER	0.0	O*O	0.0	2.0	1*5	25.0	5.0	1.8	41.1
TUBENOSE POACHER	O*O	0,0	0.0	0.0	0.0	0.0	2*0	0.3	101
PACIFIC SANDFISH	0.0	0.0	0.0	0,0	O*O	O*O	0.0	O*O	0.0
SNAKE PRICKLEBACK	1,0	4.5	100.0	2.0	8.5	130.0	3.0	2.3	43.3
CRESCENT GUNNEL	O*O	0.0	O*O	0.0	O*O	O*'O	0.0	0.0	0.0
PACIFIC SANDLANCE	0.0	0.0	O*O	0*0	O*O	0.0	2.0	0*3	3*3
FLATHEAD SOLE	1.0	2.0	60.0	0*0	O*O	0.0	1*0	0*3	10*0
BUTTER SOLE	0.0	0.0	0.0	0.0	O*O	0.0	1.0	0*1	41*7
ROCK SOLE	0.0	0.0	0.0	2.0	20.5	112.5	5.0	41.5	658 .8
YELLOWFIN SOLE	1.0	41*O	2600 .0	2*0	350.0	13225.0	6.0	143.3	7050.8
LONGHEAD DAB	O*O	O*O	0.0	0*0	0.0	0.0	3.0	0.4	27.9
STARRY FLOUNDER	O*O	0.0	0.0	1*0	0.s	262.5	2.0	0*3	168.8
ALASKA PLAICE	0.0	0.0	0*0	2.0	28.5	700.0	5.0	6.3	239.6
PACIFIC HALIBUT	0.0	0.0	0.0	0*0	0.0	0.0	2*0	0.8	32.5
Number of Species	4.0			?.0			22.0		
Mean Abundance		48*0			411*O			209.3	
Mean Weight (g)			2763*5			14520.0			8689 .3
Number of Replicates			2.0			2*0			12.0

APENDIX TABLE E-1 (cont.)

Transect 5

Common Species Name	Station 2 1502 F req	Hean Abund	Mean Weight	Station 3 1503 Freq	Mean Abund	Mean Weight	Station 4 1 504 Freq	Mean Abund	Mean Weight	Transect Summary Freq	Mean Abund	Mean Weight
empty haul	1.0	0*0	0.0	0.0	0.0	0.0	0.0	0*0	0.0	0,0	0.0	0.0
RAINBOW SMELT	0.0	0.0	0*0	0.0	0,0	0.0	0.0	0.0	0.0	0.0	0.0	0*0
PACIFIC COD	0.0	0.0	0.0	0*0	O*O	0.0	0.0	0*0	0.0	0.0	0*0	0*0
WALLEYE POLLOCK	0*0	0*0	0.0	1.0	0.5	O*5	1.0	1.0	0.s	2*0	0.5	0*3
WHITESPOTTED GREENLING	1.0	0.s	35*0	0*0	0.0	O*O	0.0	0.0	0.0	1.0	0*2	11*7
SCULPIN UNID	0*0	0*0	0.0	0*0	0.0	0.0	0.0	0*0	0.0	0.0	0.0	0.0
THREADED SCULPIN (A)	0*0	0.0	0*0	1.0	0.5	30.0	0*0	0.0	0.0	1.0	0.2	10.0
STAGHORN SCULPIN	0*0	0*0	0*0	0*0	0.0	O*O	0.0	0*0	0*0	0.0	0.0	0.0
BRIGHTBELLY SCULPIN (B)	0.0	0*0	0.0	0,0	0.0	O*O	0*0	0.0	0*0	0*0	0*0	0.0
PLAIN SCULPIN	0.0	0.0	0.0	0*0	0.0	0.0	0.0	0*0	0.0	0*0	0.0	0.0
TIDEPOOL SCULPIN (B?)	0*0	0.0	0.0	0.0	O*O	0,0	0*0	000	0*0	0.0	0.0	0.0
RIBBED SCULPIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0*0	0*0	0.0	0.0
STURGEON POACHER	0.0	0.0	0.0	0*0	O*O	O*O	1.0	0.5	55.0	1.0	0*2	1s03
BERING POACHER	0.0	0*0	0.0	0.0	0.0	O*O	2.0	7*0	175.0	1.0	2.3	58.3
TUBENOSE POACHER	0*0	0.0	0*0	0*0	O*O	0.0	0.0	0*0	0.0	0.0	0.0	0*0
PACIFIC SANDFISH	0*0	0*0	0.0	0.0	0.0	O*O	2.0	2.0	105.0	1*0	0.7	35.0
SNAKE PRICKLEBACK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0*0	0.0	0*0	0.0	0.0
CRESCENT GUNNEL	0.0	0*0	0*0	0.0	060	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PACIFIC SANDLANCE	0*0	0*0	0.0	0*0	O*O	O*O	0.0	0.0	0.0	0*0	0.0	0*0
FLATHEAD SOLE	0.0	0*0	0.0	0*0	0.0	O*O	0.0	0*0	0*0	0.0	0*0	0*0
BUTTER SOLE	0*0	0*0	0.0	0.0	0.0	0.0	0*0	0*0	0.0	0*0	0.0	0.0
ROCK SOLE	0*0	0*0	0*0	2.0	12.5	475.0	1*0	5.0	125*0	2.0	5.8	200.0
YELLOWFIN SOLE	0.0	0.0	0*0	2.0	5.0	125.0	2.0	29,0	2900.0	2*0	11.3	1008.3
LONGHEAD DAB	0.0	0*0	0*0	2.0	3.0	115*O	2*0	1.5	70.0	2.0	1.5	61.7
STARRY FLOUNDER	0*0	0*0	0.0	0*0	O*O	O*O	1.0	1.0	850.0	1*0	0*3	283.3
ALASKA PLAICE	0*0	0*0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0*0
PACIFIC HALIBUT	0.0	0*0	0*0	0.0	0.0	0.0	0.0	0.0	0.0	0*0	0.0	0*0
Number of Species	2.0			5.0			8.0			1000		
Mean Abundance		005			21*5			47.0			23.0	
Mean Weight (g)			35.0			745.5			4280.5			1687.0
Number of Replicates			2*0			2.0			2.0			6.0

APPENDIX TABLE E-2

OTTER TRAWL CATCH DATA SUMMARY FOR CRUISE 2

Transect 1

Common Species Name	Station 2 2102 Freq	Station 2 Mean Abund	Station 2 Mean Weight	Station 3 2103 Freq	Station 3 Mean Abund	Station 3 Mean Weight	Station 4 2104 Freq	Station 4 Mean Abund	Station 4 Mean Weight	Transect Summary Freq	Transect Summary Mean Abund	Transect Summary Mean Weight
PACIFIC HERRING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
RAINBOW SMELT	0.0	0.0	0.0	2.0	8.5	200.0	2.0	12.0	235.0	2.0	6.8	145.0
ARCTIC COD	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PACIFIC COD	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
WALLEYE POLLOCK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
KELP GREENLING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
WHITESPOTTED GREENLING	1.0	0.5	2.5	0.0	0.0	0.0	1.0	0.5	6.0	2.0	0.3	2.8
PADDED SCULPIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CRESTED SCULPIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
THREADED SCULPIN (A)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
STAGHORN SCULPIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PLAIN SCULPIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
RIBBED SCULPIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
STURGEON POACHER	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BERING POACHER	1.0	0.5	20.0	2.0	0.0	137.5	2.0	28.0	925.0	3.0	12.0	360.8
TUBENOSE POACHER	0.0	0.0	0.0	1.0	8.0	14.5	1.0	0.5	9.5	2.0	0.2	8.0
PACIFIC SANDFISH	0.0	0.0	0.0	0.0	1.0	0.0	2.0	1.5	61.0	1.0	0.5	20.3
SNAKE PRICKLEBACK	0.0	0.0	0.0	2.0	0.0	92.5	2.0	8.0	330.0	2.0	3.5	140.8
PACIFIC SANDLANCE	0.0	0.0	0.0	0.0	3.0	0.0	0.0	0.0	0.0	0.0	0.7	0.0
BUTTER SOLE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ROCK SOLE	1.0	0.0	55.0	0.0	0.0	0.0	2.0	0.0	5.0	2.0	1.0	20.0
YELLOWFIN SOLE	2.0	4.0	1300.0	2.0	20.0	17212.5	2.0	1.0	4700.0	3.0	15.7	7737.5
LONGHEAD DAB	0.0	42.5	0.0	1.0	51.5	2.5	1.0	52.0	32.5	2.0	0.3	11.7
STARRY FLOUNDER	1.0	0.0	275.0	0.0	0.5	0.0	2.0	2.0	3662.5	2.0	2.8	1312.5
ALASKA PLAICE	1.0	0.5	55.0	2.0	0.0	1350.0	2.0	6.5	18.0	3.0	4.3	474.3
PACIFIC HALIBUT	0.0	1.5	0.0	0.0	9.0	0.0	0.0	2.5	0.0	0.0	0.3	0.0
		0.0			0.0			0.0			0	
Number of Species	6.0			7.0			11.0			11.0		
Mean Abundance		47.5			281.5			114.5			143.5	
Mean Weight (g)			1707.5			19009.5			9984.5			10233.8
Number of Replicates			2.0			2.0			2.0			6.0

APPENDIX TABLE E-2 (cont.)

Transect 3

Common Species Name	2302 F req	Station 2 Mean Abund	Mean Weight	2303 F req	Station 3 Mean Abund	Mean Weight	2304 F req	Station 4 Mean Abund	Mean Weight	Transect Summary F req	Mean Abund	Mean Weight
PACIFIC HERRING	O*O	0.0	O*O	1.0	0.5	85.0	0*0	0.0	0.0	1.0	0.2	20.3
RAINBOW SMELT	0.0	0*0	O*O	1.0	0.5	12*5	0*0	0.0	0*0	1*0	0.2	4.2
ARCTIC con	0.0	0.0	0.0	1*0	0.5	15.0	0.0	0.0	0*0	1*0	0.2	5.0
PACIFIC C(JD	2.0	23.5	55.0	1.0	O*5	0*5	2*0	1*O	1*0	3.0	8.3	18.8
WALLEYE POLLOCK	1*O	0.5	25.0	1*0	1.0	1.5	1*0	1*O	1.0	3.0	0.8	9.2
KELP GREENLING	0.0	0.0	O*O	0*0	O*O	0*0	0*0	O*O	0.0	0.0	0.0	0.0
WHITESPOTTED GREENLING	2.0	1*0	36.0	2.0	3*O	160,0	2.0	1.0	135.0	3.0	1*7	110.3
PADDED SCULPIN	O*O	0.0	O*O	O*O	0.0	0,0	0*0	O*O	0*0	0*0	0*0	0.0
CRESTED SCULPIN	0.0	0*0	O*O	O*O	O*O	0.0	0*0	0.0	0*0	0*0	0.0	O*O
THREADED SCULPIN(A)	2*O	2.0	65.0	O*O	0.0	0.0	0.0	0.0	0*0	1.0	0*7	21.7
STAGHORN SCULPIN	0.0	0*0	O*O	O*O	0.0	060	0*0	O*O	0.0	0*0	0*0	0.0
PLAIN SCULPIN	O*O	0.0	0.0	O*O	0.0	0.0	0,0	O*O	0,0	0.0	0.0	O*O
RIBBED SCULPIN	1.0	0*S	6.0	O*O	0.0	0,0	0.0	O*O	0.0	1*0	0,2	2.0
STURGEON POACHER	0$0	0*0	O*O	1*O	0.5	2*0	0.0	O*O	0*0	1.0	0*2	O*7
BERING POACHER	0.0	0.0	0.0	0.0	0.0	0.0	2.0	S*O	175.0	1.0	2.7	58.3
TUBENOSE POACHER	0.0	0.0	O*O	0.0	O*O	0.0	0.0	O*O	0.0	0*0	0.0	O*O
PACIFIC SANDFISH	0,0	0.0	0.0	0.0	O*O	0*0	2*0	2.s	132.s	1*0	0.8	44.2
SNAKE PRICKLEBACK	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.5	7.5	1.0	0.2	2.5
PACIFIC SANDLANCE	O*O	0.0	0.0	O*O	0,0	0*0	0.0	O*O	0.0	0*0	0*0	0,0
BUTTER SOLE	0.0	0.0	O*O	0.0	0.0	0,0	0.0	0,0	0.0	0.0	0*0	O*O
ROCK SOLE	2.0	6.5	147.5	1*O	I*O	125.0	0*0	0.0	0*0	2.0	2.5	90.0
YELLOWFIN SOLE	2.0	34.0	1350.0	2*O	203.5	11225*0	2*0	16.5	1850.0	3*0	84.7	4808.3
LONGHEAD DAB	0.0	0.0	O*O	000	0.0	0*0	1*0	0.5	12.5	1.0	0.2	4.2
STARRY FLOUNDER	0.0	0*0	000	0,0	0.0	0.0	1*0	0.5	140.0	1*0	0.2	46*7
ALASKA PLAICE	1.0	0.5	10*O	2*O	1.0	111*0	2.0	3.5	82.5	300	1.7	67,0
PACIFIC HALIBUT	1.0	0.5	2*O	O*O	O*O	0.0	0*0	O*O	0*0	1.0	0*2	O*7
Number of Species	9.0			10*O			10*0			18.0		
Mean Abundance		69.0			21200			35.0			105*3	
Mean Weight (9)			1696.5			11737.5			2537.0			5323.7
Number of Replicates			200			2.0			2.0			6.0

APPENDIX TABLE E-2 (cont.)

Transect 4

Common Species Name	Station 2 2402 Freq	Station 2 Mean Abund	Station 2 Mean Weight	Station 3 2403 Freq	Station 3 Mean Abund	Station 3 Mean Weight	Station 4 2404 Freq	Station 4 Mean Abund	Station 4 Mean Weight	Station 7 2407 Freq	Station 7 Mean Abund	Station 7 Mean Weight
PACIFIC HERRING	0.0	0.0	0.0	0.0	O*O	0*0	0*0	0.0	0*0	0.0	0.0	0.0
RAINBOW SMELT	0.0	0*0	0.0	1*0	0.5	17.5	1.0	0*5	25*0	1*0	1.5	35*0
ARCTIC COD	0.0	0.0	0.0	0*0	0.0	0.0	0.0	0*0	0*0	0*0	0.0	0*0
PACIFIC COD	2.0	99.5	432*5	2*0	2.5	9.5	0.0	0.0	0.0	1*0	0*5	1.5
WALLEYE POLLOCK	0.0	0.0	O*O	0.0	0.0	000	0.0	0.0	0.0	0.0	0.0	0*0
KELP GREENLING	0.0	0*0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0*0	0.0
WHITESPOTTED GREENLING	0*0	0*0	0.0	0*0	0.0	0.0	1.0	3.0	190.0	2.0	36*0	625.0
PADDED SCULPIN	0.0	0*0	O*O	0*0	O*O	0.0	0*0	0.0	0*0	0.0	0.0	0*0
CRESTED SCULPIN	0.0	0.0	0,0	0.0	O*O	0*0	0.0	0.0	0*0	0.0	0.0	0*0
THREADED SCULPIN (n)	0.0	0*0	O*O	2*0	1.0	65.0	2.0	3*5	185.0	2*0	6.5	255.0
STAGHORN SCULPIN	0.0	0*0	0.0	0.0	O*O	0.0	0.0	0.0	0*0	0.0	0.0	0.0
PLAIN SCULPIN	0.0	0,0	O*O	0*0	O*O	0*0	0*0	0*0	0*0	1.0	0.5	625.0
RIBBED SCULPIN	0.0	0*0	O*O	0*0	0.0	0*0	0.0	0.0	0.0	0.0	0*0	0.0
STURGEON POACHER	0*0	000	O*O	0.0	O*O	0.0	0.0	0.0	0.0	0*0	0.0	0*0
BERING POACHER	0.0	0.0	0.0	0*0	0.0	0.0	0.0	0.0	0*0	0.0	0*0	0.0
TUBENOSE POACHER	0*0	0.0	0,0	0*0	0.0	0*0	1.0	1.0	12.5	1.0	0.5	1*0
PACIFIC SANDFISH	0*0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SNAKE PRICKLEBACK	0.0	0*0	O*O	0.0	O*O	0.0	0.0	0.0	0*0	0.0	0*0	0.0
PACIFIC SANDLANCE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0*0	0.0	0*0	0,0	0*0
BUTTER SOLE	0.0	0*0	O*O	0*0	0.0	0.0	0.0	0*0	0,0	0,0	0*0	0.0
ROCK SOLE	2.0	6.5	127.5	2.0	2.5	80.0	1.0	17.0	200 .0	2*0	23.5	287.5
YELLOWFIN SOLE	2*0	12.0	475.0	2.0	7*O	177.5	2.0	66.0	1800.0	2*0	249.5	2625.0
LONGHEAD DAB	1*0	0.5	15*O	0*0	0.0	0.0	0.0	0.0	0*0	0.0	0*0	0.0
STARRY FLOUNDER	1.0	0*5	200.0	0*0	O*O	0*0	0*0	0.0	0*0	0.0	0.0	0.0
ALASKA PLAICE	0.0	0*0	O*O	1*0	O*5	110*0	1.0	1*0	85.0	1.0	1*0	60.0
PACIFIC HALIBUT	0.0	0.0	0.0	0.0	0.0	0*0	1.0	1*0	35.0	2.0	2.0	195.0
Number of Species	5.0			6.0			8.0			10*0		
Mean Abundance		119.0			14.0			93.0			321.5	
Mean Weight (g)			1250.0			459.5			2532. 5			4710.0
Number of Replicates			2,0			2.0			2*0			2*0

APPENDIX TABLE E-2 (cont.)

Transect 4 (cent)

Common Species Name	Station 10 2410 Freq	Station 10 Mean Abund	Station 10 Mean Weight	Station 11 2411 Freq	Station 11 Mean Abund	Station 11 Mean Weight	Transect Summary Freq	Transect Summary Mean Abund	Transect Summary Mean Weight
PACIFIC HERRING	0.0	0.0	0.0	0*0	0.0	0.0	0,0	O*O	0*0
RAINBOW SMELT	0*0	O*O	0.0	0*0	0.0	0.0	3'.0	0.4	12.9
ARCTIC COD	0*0	O*O	0.0	0*0	O*O	0.0	0.0	O*O	0.0
PACIFIC COD	2*0	2*O	10.0	2.0	5*5	27.5	5*0	18.3	80.2
WALLEYE POLLOCK	0.0	0,0	0.0	0*0	0.0	O*O	0.0	0,0	0.0
KELP GREENLING	000	O*O	0*0	0*0	0.0	0.0	0*0	O*O	0.0
WHITESPOTTED GREENLING	2.0	9*5	97*5	2.0	9.5	25S .0	4.0	9.7	194.6
PADDED SCULPIN	0*0	O*O	0*0	0*0	O*O	O*O	0.0	0.0	0*0
CRESTED SCULPIN	0*0	0.0	0*0	0.0	0.0	0.0	'0*0	0.0	0.0
THREADED SCULPIN (A)	0*0	0.0	0.0	2.0	5*O	285.0	4.0	2.7	131.7
STAGHORN SCULPIN	0.0	0.0	0.0	0*0	0.0	0.0	0.0	0.0	0.0
PLAIN SCULPIN	2.0	6.0	6525.0	0.0	0.0	0.0	2.0	1.1	1191.7
RIBBED SCULPIN	0*0	O*O	0*0	0.0	0.0	0.0	0.0	0*0	0.0
STURGEON POACHER	0.0	O*O	0.0	0.0	0.0	O*O	0.0	0*0	0*0
BERING POACHER	0.0	0.0	0*0	0,0	0.0	0.0	0*0	0.0	0.0
TUBENOSE POACHER	1.0	O*5	2.5	1.0	0.5	1.0	4.0	0.4	2.8
PACIFIC SANDFISH	0,0	0.0	0.0	0.0	O*O	O*O	0.0	0*0	0.0
SNAKE PRICKLEBACK	2,0	14.5	175.0	0.0	O*O	0.0	1*0	2,4	29.2
PACIFIC SANDLANCE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BUTTER SOLE	0.0	0.0	0.0	0*0	0.0	0.0	0.0	0*0	0.0
ROCK SOLE	0.0	0.0	0*0	0.0	0.0	0.0	4*0	B*3	115.6
YELLOWFIN SOLE	2,0	246.5	16910.0	2.0	47s,0	14150.0	6,0	176.5	6022.9
LONGHEAD DAB	0.0	0.0	0*0	0*0	0.0	0.0	1*0	0*1	2.5
STARRY FLOUNDER	100	O*5	32*5	1.0	O*S	80.0	3*0	0.3	52.1
ALASKA PLAICE	2.0	9.0	210.0	2.0	10.0	925+O	5.0	3.6	231.7
PACIFIC HALIBUT	0.0	0.0	0.0	0.0	0.0	0.0	2.0	0.5	38.3
Number Of Species	8.0			7*0			13*0		
Mean Abundance		288 .5			509.o			224.2	
Mean Weight (g)			23962. S			15723.5			8106.3
Number of Replicates			2*0			2.0			12.0

APPENDIX TABLE E-2 (cont.)

Transect 5 (cont.)

Common Species Name	Station 2: 2502 Freq	Station 2: Mean Abund	Station 2: Mean Weight	Station 3: 2503 Freq	Station 3: Mean Abund	Station 3: Mean Weight	Station 4: 2504 Freq	Station 4: Mean Abund	Station 4: Mean Weight	Transect Summary: Freq	Transect Summary: Mean Abund	Transect Summary: Mean Weight
PACIFIC HERRING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
RAINBOW SMELT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ARCTIC COD	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PACIFIC COD	2.0	15.0	[illegible].5	2.0	12.5	22.5	2.0	26.0	50.0	3.0	17.8	37.7
WALLEYE POLLOCK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
KELP GREENLING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
WHITESPOTTED GREENLING	0.0	0.0	0.0	1.0	0.5	3.5	0.0	0.0	0.0	1.0	0.2	1.2
PADDED SCULPIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CRESTED SCULPIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
THREADED SCULPIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
STAGHORN SCULPIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PLAIN SCULPIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
RIBBED SCULPIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
STURGEON POACHER	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BERING POACHER	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.5	15.0	0.0	0.2	5.0
TUBENOSE POACHER	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PACIFIC SANDFISH	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SNAKE PRICKLEBACK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PACIFIC SANDLANCE	0.0	0.0	0.0	1.0	1.5	3.0	1.0	0.5	1.5	0.0	0.7	1.5
BUTTER SOLE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ROCK SOLE	2.0	45.5	1537.5	2.0	75.5	1000.0	2.0	10.0	262.5	3.0	43.7	933.3
YELLOWFIN SOLE	0.0	0.0	0.0	2.0	2.0	27.0	2.0	25.0	387.5	2.0	9.0	138.2
LONGHEAD DAB	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
STARRY FLOUNDER	2.0	2.0	2575.0	0.0	0.0	0.0	2.0	0.0	805.0	2.0	0.0	1126.7
ALASKA PLAICE	0.0	0.0	0.0	0.0	0.0	0.0	2.0	1.0	112.5	1.0	1.0	37.5
PACIFIC HALIBUT	2.0	1.5	60.0	0.0	0.0	0.0	1.0	2.5	25.0	2.0	0.8	28.3
Number of Species	4.0			5.0			8.0			9.0		
Mean Abundance		64.0			[illegible]2.0			66.0			71.0	
Mean Weight (g)			4213.0			1056.0			1659.0			2309.3
Number of Replicates			2.0			2.0			2.0			6.0

APPENDIX TABLE E-2 (cont.)

Transect 6

Common Species Name	Station 2 2602 Freq	Station 2 Mean Abund	Station 2 Mean Weight	Station 3 2603 Freq	Station 3 Mean Abund	Station 3 Mean Weight	Station 4 2604 Freq	Station 4 Mean Abund	Station 4 Mean Weight	Station 7 2607 Freq	Station 7 Mean Abund	Station 7 Mean Weight
PACIFIC HERRING	0.0	0.0	0*0	0.0	0.0	0*0	0*0	0.0	0.0	0*0	O*O	0*0
RAINBOW SMELT	0.0	0.0	0.0	0$0	0.0	0.0	0*0	0.0	O*O	0*0	0.0	0*0
ARCTIC COD	0.0	0.0	0.0	0*0	0.0	0*0	0,0	0.0	0.0	0.0	O*O	0.0
PACIFIC COD	2*O	88,5	125,0	2*0	15.5	37.s	2*0	7.5	22.5	2.0	133.0	625.0
WALLEYE POLLOCK	0.0	O*O	0*0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
KELP GREENLING	0.0	O*O	0*0	0*0	0.0	0.0	000	0*0	0.0	0.0	0.0	0*0
WHITESPOTTED GREENLING	0.0	0,0	0*0	0*0	0.0	0.0	1.0	1.0	SO*O	0*0	O*O	0.0
PADDED SCULPIN	O*O	000	0.0	0.0	0.0	0.0	0*0	0.0	0.0	1*0	1.5	27.5
CRESTED SCULPIN	1.0	O*5	5.0	0.0	0*0	0*0	0*0	0.0	0.0	0.0	0.0	0.0
THREADED SCULPIN (A)	1*O	0.5	0.5	0.0	0,0	0*0	0.0	0*0	0.0	0*0	0.0	0*0
STAGHORN SCULPIN	1.0	O*5	200.0	2.0	2.s	5s0 .o	2.0	4*5	1025.o	0.0	O*O	0.0
PLAIN SCULPIN	O*O	0.0	0.0	1.0	0.5	000 .o	0*0	0*0	0.0	1.0	0.5	20.0
RIBRED SCULPIN	0.0	0.0	0*0	0.0	0.0	0*0	0.0	0.0	0.0	0.0	O*O	0.0
STURGEON POACHER	0.0	0.0	0*0	0.0	0.0	0*0	1.0	1.0	37.5	2*0	5.0	150.0
BERING POACHER	0.0	0.0	0*0	100	0*5	5.0	1.0	1.5	17.5	1*0	1.5	12.5
TUBENOSE POACHER	1*O	0.5	0.5	0*0	0.0	0.0	1.0	0.5	1.0	2.0	2.0	6.S
PACIFIC SANDFISH	O*O	O*O	0.0	0.0	0*0	0.0	1.0	0*5	25.0	0*0	O*O	0.0
SNAKE PRICKLEBACK	1.0	0.5	0*5	0*0	0*0	0*0	1.0	100	5*O	0*0	O*O	0*0
PACIFIC SANDLANCE	0.0	O*O	0.0	100	0.5	3.5	2.0	4.0	10*O	0.0	0,0	0.0
BUTTER SOLE	2*O	3.5	337,5	2.0	3*0	225.0	2.0	2,0	105.0	0*0	0.0	0.0
ROCK SOLE	2.0	56,0	550.0	2*0	12.0	52.5	0*0	0.0	0.0	2.0	8.5	187.5
YELLOWFIN SOLE	2*O	63*O	1387.5	2.0	92.5	2300.0	2*0	91*0	3800.0	2*0	3*O	07.5
LONGHEAD DAB	O*O	0.0	0*0	0.0	0*0	0.0	0.0	0.0	0.0	000	0.0	0.0
STARRY FLOUNDER	0.0	O*O	0.0	0*0	0.0	0*0	2*0	1.5	1850.0	2.0	3.5	3675.0
ALASKA PLAICE	1*O	0.5	30,0	0*0	0*0	0*0	2.0	3.5	72.5	0*0	0.0	0*0
PACIFIC HALIBUT	0.0	0.0	0.0	1*0	1*0	0*5	0.0	0*0	O*O	1.0	1*O	112.5
Number of Species	10*O			9*0			13*0			10*0		
Mean Abundance		214.0			128.0			119.5			159.5	
Mean Weight (g)			2636.5			3974*0			7021.0			4904.0
Number of Replicate			2*0			2.0			2*O			2.0

APPENDIX TABLE E-2 (cont.)

Transect 6 (cont.)	Station 8			Station 9			Transect Summary		
Common Species Name	2608 Freq	Mean Abund	Mean Weight	2609 F req	Mean Abund	Mean Weight	F req	Mean Abund	Mean Weight
PACIFIC HERRING	0.0	0*0	0.0	0*0	0.0	0*0	0.0	0.0	0.0
RAINBOW SMELT	0.0	0*0	0.0	1.0	1.0	125.0	1.0	0,2	20.8
ARCTIC COD	0.0	0.0	0*0	0.0	0*0	0.0	0.0	0*0	0.0
PACIFIC COD	1.0	0.5	1*0	2,0	6.5	17.0	6.0	41.9	138.0
WALLEYE POLLOCK	0*0	0*0	0.0	0.0	0.0	0.0	0.0	0.0	0*0
KELP GREENLING	0*0	0.0	0*0	2*0	1*0	2.5	1.0	0*2	0.4
WHITESPOTTED GREENLING	1.0	0.s	1.5	2.0	46.0	287.5	3.0	7*9	56.5
PADDED SCULPIN	0.0	0*0	0*0	0*0	0*0	0*0	1*0	0.3	4,6
CRESTED SCULPIN	0.0	0*0	0.0	0*0	0*0	0*0	1.0	0.1	0.8
THREADED SCULPIN (A)	0*0	0.0	0*0	0.0	0*0	0.0	1.0	0*1	0*1
STAGHORN SCULPIN	1*0	0.5	07.5	1.0	1.0	250.o	5.0	1.5	352.1
PLAIN SCULPIN	0*0	0*0	0*0	0*0	0*0	0.0	2*0	0.2	136.7
RIBBED SCULPIN	0*0	0.0	0.0	0.0	0.0	0.0	0*0	0*0	0.0
STURGEON POACHER	1.0	1.0	3*0	2.0	3.5	32.s	4*0	1*8	37.2
BERING POACHER	0.0	0*0	0.0	0.0	0*0	0.0	3*0	0.6	5.8
TUBENOSE POACHER	0.0	0*0	0.0	1*0	1.0	0*S	4.0	0.7	1.4
PACIFIC SANDFISH	0*0	0*0	0.0	0*0	0.0	0.0	1.0	0.1	4.2
SNAKE PRICKLEBACK	0*0	0.0	0.0	0.0	0*0	0*0	2*0	0.3	0.9
PACIFIC SANDLANCE	0.0	0.0	0*0	0.0	0*0	0.0	2*0	0.8	2.3
BUTTER SOLE	0*0	0.0	0*0	0.0	0.0	0.0	3.0	1.4	111.3
ROCK SOLE	0*0	0.0	0.0	2*0	4*5	87.5	4.0	13.5	146.3
YELLOWFIN SOLE	1.0	1*0	45.0	2*0	15.s	362.5	6.0	44*3	1330,4
LONGHEAD DAB	0*0	0.0	0*0	0*0	0.0	0*0	000	0.0	0*0
STARRY FLOUNDER	2*0	1*S	1107.5	2*0	3.5	2207.5	4.0	1*7	1486.7
ALASKA PLAICE	0.0	0*0	0.0	0*0	0*0	0.0	2*0	0.7	17.1
PACIFIC HALIBUT	0*0	0*0	0.0	2.0	8.0	75.0	3.0	1.7	31.3
Number of Species	6.0			11.0			21.0		
Mean Abundance		5*0			91*S			119.6	
Mean Weight (a)			1245.5			3527.5			3884 . e
Number of Replicates			2.0			2*0			12.0

APPENDIX TABLE E-3

OTTER RAWL CA'CH DA' SUMMARY FOR CRUISE 3

Common Species Name	Station 2 3102 Freq	Station 2 Mean Abund	Station 2 Mean Weight	Station 3 3103 Freq	Station 3 Mean Abund	Station 3 Mean Weight	Station 4 3104 Freq	Station 4 Mean Abund	Station 4 Mean Weight	Transect Summary Freq	Transect Summary Mean Abund	Transect Summary Mean Weight
empty haul	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SMELT UNID	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SURF SMELT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
RAINBOW SMELT	0.0	0.0	0.0	2.0	9.0	0.0	2.0	31.0	427.5	2.0	3.3	179.2
EULACHON	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PACIFIC COD	2.0	4.0	7.0	1.0	7.5	20.0	2.0	27.5	100.0	3.0	3.0	42.3
WALLEYE POLLOCK	0.0	0.0	0.0	1.0	0.5	0.5	1.0	0.5	2.5	2.0	0.3	1.0
KELP GREENLING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
WHITESPOTTED GREENLING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SCULPIN UNID	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SILVERSPOT SCULPIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
THREADED SCULPIN (A)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
STAGHORN SCULPIN	0.0	0.0	0.0	1.0	0.5	275.0	0.0	0.0	0.0	1.0	0.2	91.7
PLAIN SCULPIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
GREAT SCULPIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SAILFIN SCULPIN	0.0	0.0	0.0	1.0	0.5	30.0	1.0	0.5	27.5	2.0	0.3	19.2
RIBBED SCULPIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
STURGEON POACHER	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BERING POACHER	2.0	1.5	40.0	1.0	6.0	10.0	2.0	5.0	95.0	3.0	4.2	81.7
TUBENOSE POACHER	0.0	0.0	0.0	2.0	2.0	3.5	2.0	11.5	42.5	2.0	4.5	15.3
LIPARIS SP.	0.0	0.0	0.0	0.0	0.0	0.0	2.0	2.0	4.0	1.0	0.7	1.3
PACIFIC SANDFISH	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SNAKE PRICKLEBACK	1.0	0.5	7.5	2.0	6.0	75.0	2.0	98.0	950.0	3.0	34.8	344.2
CRESCENT GUNNEL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PACIFIC SANDLANCE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BUTTER SOLE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ROCK SOLE	1.0	2.5	25.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.8	8.3
YELLOWFIN SOLE	2.0	8.5	290.0	2.0	60.0	9250.0	2.0	4.0	810.0	3.0	0.7	3450.0
LONGHEAD DAB	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.0	27.0	0.0
ARCTIC FLOUNDER	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	45.0	1.0	0.2	15.0
STARRY FLOUNDER	1.0	0.5	80.0	2.0	2.5	1175.0	1.0	0.5	187.5	3.0	0.2	480.8
ALASKA PLAICE	0.0	0.0	0.0	2.0	7.5	500.0	2.0	7.5	125.0	2.0	1.8	208.3
PACIFIC HALIBUT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.0	0.0
Number of Species	6.0			11.0			12.0			14.0		
Mean Abundance		27.5			102.0			188.5			106.0	
Mean Weight (g)			449.5			11549.0			2816.5			4938.3
Number of Replicates			2.0			2.0			2.0			6.0

APPENDIX TABLE E-3 (cont.)

Transect 2

Common Species Name	Station 1 3201 Freq	Station 1 Mean Abund	Station 1 Mean Weight	Station 2 3202 Freq	Station 2 Mean Abund	Station 2 Mean Weight	Station 3 3203 Freq	Station 3 Mean Abund	Station 3 Mean Weight	Station 4 3204 Freq	Station 4 Mean Abund	Station 4 Mean Weight
empty haul	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SMELT UNID	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SURF SMELT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
RAINBOW SMELT	1.0	4.5	140.0	2.0	2.0	18.0	2.0	3.0	120.0	2.0	3.0	45.0
EULACHON	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PACIFIC COD	2.0	82.5	270.0	2.0	318.0	875.0	2.0	340.5	825.0	2.0	105.5	200.0
WALLEYE POLLOCK	2.0	6.0	23.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
KELP GREENLING	1.0	0.5	2.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
WHITESPOTTED GREENLING	2.0	[illegible].5	55.0	1.0	6.0	75.0	0.0	0.0	0.0	1.0	3.5	65.0
SCULPIN UNID	0.0	[illegible].0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SILVERSPOT SCULPIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
THREADED SCULPIN (A)	2.0	[illegible].0	217.5	2.0	2.5	55.0	0.0	0.0	0.0	0.0	0.0	0.0
STAGHORN SCULPIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PLAIN SCULPIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
GREAT SCULPIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SAILFIN SCULPIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
RIBBED SCULPIN	1.0	0.5	100.0	1.0	1.0	10.0	0.0	0.0	0.0	0.0	0.0	0.0
STURGEON POACHER	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BERING POACHER	0.0	0.0	0.0	0.0	0.0	0.0	2.0	6.5	122.5	0.0	0.0	0.0
TUBENOSE POACHER	0.0	0.0	0.0	0.0	0.0	0.0	2.0	2.5	6.0	0.0	0.0	0.0
LIPARIS SP.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	[illegible]	0.0	2.5
PACIFIC SANDFISH	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0
SNAKE PRICKLEBACK	0.0	0.0	0.0	0.0	0.0	0.0	2.0	21.5	157.5	0.0	0.0	0.0
CRESCENT GUNNEL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PACIFIC SANDLANCE	0.0	0.0	0.0	1	[illegible]	1.0	2.0	4.5	6.0	0.0	0.0	0.0
BUTTER SOLE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ROCK SOLE	2.0	0.0	775.0	0.0	0.0	0.0	1.0	2.5	7.5	0.0	0.0	0.0
YELLOWFIN SOLE	2.0	7.5	175.0	2.0	16.0	55.0	2.0	79.0	3007.5	2.0	0.0	110.0
LONGHEAD DAB	0.0	10.5	0.0	0.0	0.0	0.0	2.0	1.5	75.0	0.0	5.0	0.0
ARCTIC FLOUNDER	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	20.0
STARRY FLOUNDER	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	250.0	0.0	1.0	0.0
ALASKA PLAICE	0.0	0.0	0.0	1.0	0.0	5.0	2.0	25.5	1162.5	1.0	0.0	10.0
PACIFIC HALIBUT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0
Number of Species	9.0			8.0			11.0			7.0		
Mean Abundance		117.5			346.5			488.0			119.5	
Mean Weight (g)			1758.5			1194.0			5739.5			452.5
Number of Replicates			2.0			2.0			2.0			2.0

APPENDIX TABLE E-3 (cont.)

Transect 2 (cont.)

Common Species Name	Transect Summary F req	Mean Abund	Mean Weight
empty haul	0.0	0.0	O*O
SMELT UNID	0.0	0.0	O*O
SURF SMELT	0*0	0.0	0.0
RAINBOW SMELT	4.0	3*1	00.8
EULACHON	0.0	0.0	O*O
PACIFIC COD	4*0	211.6	542.5
WALLEYE POLLOCK	1*0	1*5	5.9
KELP GREENLING	1.0	O*1	0.6
WHITESPOTTED GREENLINE	3.0	3.5	48.8
SCULPIN UNID	0.0	0.0	0.0
SILVERSPOT SCULPIN	0*0	0.0	0.0
THREADED SCULPIN (A)	2.0	0.9	68.1
STAGHORN SCULPIN	0.0	O*O	0*0
PLAIN SCULPIN	0.0	0.0	0.0
GREAT SCULPIN	0*0	0.0	0.0
SAILFIN SCULPIN	0.0	0.0	0.0
RIBBED SCULPIN	2.0	0.4	27.5
STURGEON POACHER	0.0	O*O	0.0
BERING POACHER	1.0	1,6	30,6
TUBENOSE POACHER	1.0	0.6	1*S
LIPARIS SP.	1.0	0.1	0.6
PACIFIC SANDFISH	0.0	0.0	0.0
SNAKE PRICKLEBACK	1*0	5.4	39.4
CRESCENT GUNNEL	0.0	O*O	0*0
PACIFIC SANDLANCE	2.0	1*3	1.8
BUTTER SOLE	0.0	0.0	0*0
ROCK SOLE	2.0	2.5	195.6
YELLOWFIN SOLE	4.0	27.6	861•9
LONGHEAD DAB	1.0	0.4	18.8
ARCTIC FLOUNDER	1*0	0.3	5.0
STARRY FLOUNDER	1.0	0.3	62.5
ALASKA PLAICE	3.0	6.8	294.4
PACIFIC HALIBUT	0.0	0.0	0.0
Number of Species	18.0		
Mean Abundance		267.9	
Mean Weight (g)			2286.1
Number of Replicates			8*0

APPENDIX TABLE E-3 (cont.)

Transect 3

Common Species Name	Station 2 3302 Freq	Mean Abund	Mean Weight	Station 3 3303 Freq	Mean Abund	Mean Weight	Station 4 3304 Freq	Mean Abund	Mean Weight	Transect Summary Freq	Mean Abund	Mean Weight
empty haul	0.0	0*0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0*0
SMELT UNID	0.0	0.0	0*0	0*0	0.0	O*O	0.0	0,0	0.0	0*0	0.0	0*0
SURF SMELT	0.0	0*0	0.0	0.0	0*0	0.0	0*0	0*0	0*0	0*0	O*O	0.0
RAINBOW SMELT	0*0	0*0	0*0	2*0	10*0	222.5	2*0	34.5	227.5	2.0	14.8	150.0
EULACHON	0.0	0*0	0*0	0.0	0.0	O*O	0*0	0.0	0*0	0*0	O*O	0*0
PACIFIC COD	2,0	37,0	120.0	2*0	59.0	145.0	2*0	IO*0	180.0	3.0	35.3	148.3
WALLEYE POLLOCK	0*0	0*0	0,0	0.0	0*0	0.0	0*0	0*0	0.0	000	0.0	0*0
KELP GREENLING	0*0	0*0	000	0*0	0*0	O*O	0*0	0.0	0.0	0.0	O*O	0.0
WHITESPOTTED GREENLING	2.0	7.0	165*0	1*0	0.5	30.0	1.0	0*5	50.0	3.0	2,7	81.7
SCULPIN UNID	0*0	0*0	0,0	0.0	0*0	O*O	0*0	0.0	0*0	0.0	0.0	O*O
SILVERSPOT SCULPIN	0.0	0*0	0.0	0*0	0.0	0.0	0,0	0*0	0*0	0.0	0.0	0.0
THREADED SCULPIN (A)	1.0	0*S	2.5	0.0	0.0	O*O	0*0	0.0	0.0	1*0	0.2	0.8
STAGHORN SCULPIN	0*0	0.0	0*0	0.0	0*0	O*O	0.0	0.0	0.0	0.0	0.0	O*O
PLAIN SCULPIN	0*0	0,0	0.0	0*0	0.0	0,0	0.0	0.0	0.0	0.0	0.0	0.0
GREAT SCULPIN	0*0	0*0	0,0	0*0	0.0	0.0	0*0	0.0	0*0	0*0	O*O	0.0
SAILFIN SCULPIN	0*0	0.0	0,0	0.0	0.0	0.0	0*0	0*0	0.0	0.0	0.0	0.0
RIBBED SCULPIN	1.0	1*0	10.0	0.0	0.0	O*O	0*0	0*0	0.0	1*0	0.3	3.3
STURGEON POACHER	0*0	0*0	0.0	0.0	0.0	O*O	1.0	0.5	1,5	1*0	0.2	0.5
BERING POACHER	0*0	0.0	0.0	2.0	11.5	237.5	2*0	18*0	340.0	200	9.8	192.5
TUBENOSE POACHER	0*0	0.0	0*0	0.0	0*0	0.0	0*0	0.0	0*0	0.0	0.0	O*O
LIPARIS SP.	0.0	0*0	0.0	0.0	0*0	O*O	0.0	0.0	0*0	0.0	O*O	0.0
PACIFIC SANDFISH	0*0	0*0	0*0	0.0	0.0	O*O	2*0	1.0	80.0	1.0	O*3	26.7
SNAKE PRICKLEBACK	0.0	0.0	0.0	1*0	0.5	5.0	1*0	1*0	65,0	2*0	0.5	23.3
CRESCENT GUNNEL	0.0	0*0	0.0	0.0	0*0	O*O	0.0	0.0	0.0	0*0	O*O	0.0
PACIFIC SANDLANCE	0.0	0.0	0.0	1.0	0*5	5*O	1.0	0.5	0.5	2.0	0.3	1.8
BUTTER SOLE	0.0	0*0	0*0	0.0	0.0	000	0*0	0.0	0.0	0.0	0.0	0.0
ROCK SOLE	2.0	6.0	155.0	2.0	1*0	37.s	1.0	0.5	15*0	3.0	2.5	69.2
YELLOWFIN SOLE	2.0	29.S	1300.0	2*0	84.0	4575.0	2.0	198.5	6250.0	3.0	104.0	4041.7
LONGHEAD DAB	0,0	0*0	0*0	1.0	0.5	15*O	2.0	38.5	1000.0	2.0	13*O	338.3
ARCTIC FLOUNDER	0.0	0.0	0.0	0*0	0.0	0.0	0,0	0.0	0*0	0.0	0.0	0.0
STARRY FLOUNDER	0.0	0.0	0*0	0.0	0.0	0.0	1.0	0.5	87.5	1.0	O*2	29,2
ALASKA PLAICE	0*0	0.0	0*0	2*0	7*0	226.5	0.0	0.0	0*0	1*0	2.3	75.5
PACIFIC HALIBUT	1*0	0.5	3s.0	0.0	0.0	0.0	0.0	0.0	0.0	1*0	0.2	11*7
Number of Species	7.0			10.0			12.0			16.0		
Mean Abundance		81.5			174.5			304,0			186,7	
Mean Weight (g)			1787.5			5499.0			8297.0			5194.5
Number of Replicates			2.0			2.0			2.0			6.0

APPENDIX TABLE E-3 (cont.)

Transect 4

Common Species Name	Station 2 3402 Freq	Station 2 Mean Abund	Station 2 Mean Weight	Station 3 3403 Freq	Station 3 Mean Abund	Station 3 Mean Weight	Station 4 3404 Freq	Station 4 Mean Abund	Station 4 Mean Weight	Station 7 3407 Freq	Station 7 Mean Abund	Station 7 Mean Weight
empty haul	0.0	0.0	0.0	2.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SMELT UNID	0.0	0*0	0.0	0*0	0.0	0.0	0*0	0*0	0*0	0*0	0.0	0*0
SURF SMELT	0*0	0*0	0.0	0.0	0*0	0.0	0.0	0*0	0*0	0.0	0,0	0.0
RAINBOW SMELT	0.0	0*0	0*0	0.0	0*0	0*0	1.0	6.S	50.0	2*0	3.0	5*0
EULACHON	0.0	0*0	0.0	0.0	0.0	0.0	1*0	4.5	60.0	0.0	0.0	0*0
PACIFIC COD	2*0	23.5	82.5	0.0	0*0	0.0	2.0	83.0	322.5	1.0	2*0	10.0
WALLEYE POLLOCK	0*0	0*0	0*0	0*0	0*0	0*0	0.0	0*0	0.0	0.0	0.0	0.0
KELP GREENLING	0.0	0.0	0.0	0.0	0.0	0*0	0.0	0.0	0.0	0.0	0.0	0.0
WHITESPOTTED GREENLING	1*0	0.5	7.5	0*0	0.0	0.0	2.0	104*5	1750.0	2.0	33.5	650.0
SCULPIN UNID	1.0	0.S	1.5	0.0	0.0	0.0	0*0	0.0	0.0	0*0	0.0	0*0
SILVERSPOT SCULPIN	0*0	0*0	0.0	0*0	0*0	0.0	0*0	0.0	0.0	0.0	0.0	0.0
THREADED SCULPIN (A)	0.0	0.0	0.0	0*0	0.0	0.0	0.0	0.0	0.0	2.0	3.5	80.0
STABHORN SCULPIN	0*0	0.0	0*0	0.0	0.0	0*0	1.0	0.5	11.0	0.0	0.0	0.0
PLAIN SCULPIN	0*0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	O*O	0.0	0*0	0.0
GREAT SCULPIN	0.0	0*0	0.0	0.0	0.0	0*0	0.0	0*0	0,0	0.0	0.0	0.0
SAILFIN SCULPIN	0.0	0*0	0.0	0*0	0.0	0*0	0*0	0.0	0,0	0.0	0*0	0*0
RIBBED SCULPIN	0*0	0*0	0.0	0*0	0.0	0*0	0*0	0.0	O*O	0*0	0.0	0.0
STURGEON POACHER	0.0	0*0	0,0	0.0	0.0	0.0	0.0	0*0	0.0	0.0	0*0	0.0
BERING POACHER	2.0	1.0	15*0	0*0	0.0	0.0	0*0	0.0	0,0	0*0	000	0.0
TUBENOSE POACHER	0.0	0.0	0.0	0*0	0*0	0.0	0.0	0*0	0.0	0.0	0.0	0*0
LIPARIS SP.	0.0	0*0	0.0	0*0	0*0	0.0	0.0	0.0	0.0	0.0	0*0	0.0
PACIFIC SANDFISH	1.0	1*0	105.0	0.0	0.0	0.0	0.0	0*0	O*O	0*0	0.0	0.0
SNAKE PRICKLEBACK	0.0	0.0	0,0	0.0	0.0	0.0	0*0	0*0	0,0	0*0	0.0	0.0
CRESCENT GUNNEL	0*0	0.0	0.0	0*0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0*0
PACIFIC SANDLANCE	1.0	0.5	1*0	0.0	0*0	0.0	0.0	0.0	O*O	0.0	0.0	0.0
BUTTER SOLE	0*0	0.0	0.0	0*0	0*0	0.0	0*0	0.0	O*O	0,0	0*0	0.0
ROCK SOLE	2*0	10.5	125.0	0.0	0.0	0*0	1.0	3*5	75*O	100	13.5	237.5
YELLOWFIN SOLE	2*0	6.5	115.0	0.0	0.0	0.0	2.0	16.5	350.0	2*0	43.0	1300.0
LONGHEAD DAB	0.0	0.0	0.0	0.0	0*0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ARCTIC FLOUNDER	0.0	0*0	0.0	0.0	0*0	0.0	0.0	0.0	0.0	0*0	0.0	0*0
STARRY FLOUNDER	1.0	0.5	283.5	0*0	0.0	0.0	0.0	0.0	O*O	0.0	0.0	0.0
ALASKA PLAICE	0*0	0*0	0.0	0*0	0.0	0.0	0*0	0.0	0.0	0.0	0*0	0.0
PACIFIC HALIBUT	0*0	0.0	0.0	0.0	0.0	0*0	0.0	0.0	O*O	1*0	1.0	55*0
Number of Species	9,0			1*0			7*0			7,0		
Mean Abundance		44.5			0.0			219.0			99.5	
Mean Weight (g)			736,0			0.0			2618.5			2337.5
Number of Replicates			2*0			2.0			2.0			2,0

APPENDIX TABLE E-3 (cont.)

Transect 4 (cont.)

Common Species Name	Station 10 3410 F req	Station 10 Mean Abund	Station 10 Mean Weight	Transect Summary Freq	Transect Summary Mean Abund	Transect Summary Mean Weight
empty haul	O*O	0.0	0.0	O*O	0.0	0.0
SMELT UNID	1*0	1.0	4*0	1*0	0.2	0.8
SURF SMELT	0.0	0*0	0.0	0*0	0*0	0.0
RAINBOW SMELT	1.0	1.5	15.0	3.0	2*2	14*O
EULACHON	0*0	0.0	0.0	1.0	0*9	12*O
PACIFIC COD	2.0	90.5	201.0	4*0	39.8	123.2
WALLEYE POLLOCK	0.0	0.0	0*0	0.0	0.0	0.0
KELP GREENLING	0*0	0.0	0.0	0*0	0*0	0.0
WHITESPOTTED GREENLING	1*0	1.0	10,0	4.0	27.9	483.5
SCULPIN UNID	0.0	0*0	0.0	1.0	0.1	0.3
SILVERSPOT SCULPIN	0.0	0.0	0*0	0.0	0*0	O*O
THREADED SCULPIN (#1)	0.0	0*0	0*0	1.0	0.7	16.0
STAGHORN SCULPIN	0.0	0.0	0.0	1.0	0.1	2*2
PLAIN SCULPIN	0.0	0.0	0*0	0*0	0.0	0.0
GREAT SCULPIN	0.0	0.0	0*0	0.0	0.0	O*O
SAILFIN SCULPIN	0.0	0.0	0*0	0*0	0.0	O*O
RIBBED SCULPIN	0.0	0.0	0.0	0.0	0.0	O*O
STURGEON POACHER	0*0	0*0	0*0	0*0	0.0	0.0
BERING POACHER	0.0	0.0	0*0	1.0	0.2	3*O
TUBENOSE POACHER	0*0	0*0	0*0	0.0	0.0	0.0
LIPARIS SP.	0.0	0.0	0,0	0.0	0.0	0.0
PACIFIC SANDFISH	0*0	0.0	0.0	1*0	0*2	21*O
SNAKE PRICKLERACK	0.0	0*0	0.0	0.0	0*0	0.0
CRESCENT GUNNEL	0*0	0.0	0.0	0*0	0.0	0.0
PACIFIC SANDLANCE	0.0	0*0	0.0	1.0	0.1	O*2
BUTTER SOLE	0.0	0*0	0.0	0,0	0*0	O*O
ROCK SOLE	0.0	0.0	0*0	3.0	5.5	87.5
YELLOWFIN SOLE	2.0	12*5	1005.0	4.0	15.7	554*O
LONGHEAD DAB	0.0	0.0	0*0	0.0	0.0	0.0
ARCTIC FLOUNDER	0*0	0*0	0.0	0*0	0.0	0.0
STARRY FLOUNDER	0.0	0.0	0.0	1*0	0*1	56,7
ALASKA PLAICE	0.0	0*0	0.0	0.0	0.0	0.0
PACIFIC HALIBUT	0.0	0*0	0*0	1.0	0.2	11.0
Number of Species	S*0			15.0		
Mean Abundance		106*5			93.9	
Mean Weight (g)			1235.0			1305.4
Number of Replicates			2.0			10.0

APPENDIX TABLE E-3 (cont.)

Transect 5 Common Species Name	Station 3 3503 Freq	Mean Abund	Mean Weight	Station 4 3504 Freq	Mean Abund	Mean Weight	Transect Summary Freq	Mean Abund	Mean Weight
empty haul	1.0	0*0	0.0	0.0	0*0	0.0	0.0	0.0	0*0
SMELT UNID	0.0	0.0	0.0	0,0	0*0	0.0	0*0	060	0*0
SURF SMELT	0.0	0.0	0*0	0*0	0*0	0.0	0.0	0.0	0*0
RAINBOW SMELT	0*0	0*0	0.0	1.0	1.5	60,0	1.0	0.8	30.0
EULACHON	0*0	000	0.0	0.0	0.0	O*O	0.0	O*O	0.0
PACIFIC COD	1*0	4*0	15.0	2.0	39.5	120.0	2*0	21.8	67.5
WALLEYE POLLOCK	0*0	0*0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
KELP GREENLING	0.0	0.0	0*0	0.0	0.0	O*O	0.0	O*O	0.0
WHITESPOTTED GREENLING	0.0	0*0	0.0	0.0	0.0	0.0	0.0	O*O	000
SCULPIN UNID	000	0.0	0*0	0.0	0*0	O*O	0.0	0.0	0*0
SILVERSPOT SCULPIN	0*0	0.0	0*0	0.0	0.0	O*O	0*0	0.0	0.0
THREADED SCULPIN (A)	0*0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
STAGHORN SCULPIN	0.0	0*0	0*0	0*0	0*0	0.0	0.0	0.0	0*0
PLAIN SCULPIN	0.0	0.0	0*0	0.0	0.0	0.0	0.0	O*O	0.0
GREAT SCULPIN	0,0	0*0	0*0	0.0	0.0	0.0	0*0	0.0	0.0
SAILFIN SCULPIN	0*0	0,0	0*0	0.0	0.0	0.0	0.0	O*O	0.0
RIBBED SCULPIN	0.0	0.0	0.0	0.0	0.0	0.0	0*0	O*O	0.0
STURGEON POACHER	0*0	0,0	0.0	0.0	0.0	0.0	0*0	0.0	0.0
BERING POACHER	0.0	0.0	0.0	0.0	0.0	0.0	0*0	0.0	0*0
TUBENOSE POACHER	0*0	0*0	0.0	0*0	0,0	O*O	0*0	0.0	0*0
LIPARIS SP.	0.0	0*0	0.0	0*0	0.0	0.0	0.0	0.0	0.0
PACIFIC SANDFISH	0*0	0*0	0.0	1*0	0.5	5*O	1.0	O*3	2*5
SNAKE PRICKLEBACK	0.0	0*0	0.0	1.0	0.5	IO*O	1.0	O*3	5*0
CRESCENT GUNNEL	0*0	0.0	0.0	0*0	0*0	0.0	0.0	O*O	0.0
PACIFIC SANDLANCE	0.0	0*0	0.0	0*0	0.0	O*O	0.0	0.0	0*0
BUTTER SOLE	0.0	0*0	0.0	0.0	0*0	O*O	0.0	0.0	0*0
ROCK SOLE	1*0	1*0	S*0	0*0	0*0	O*O	1*0	0.5	2*5
YELLOWFIN SOLE	1.0	1.0	5.0	2*0	2*0	145*O	2*0	1.5	75.0
LONGHEAD DAB	0.0	000	000	0*0	0.0	0.0	0.0	0.0	0.0
ARCTIC FLOUNDER	0.0	0.0	0*0	0*0	0*0	0.0	0*0	O*O	0.0
STARRY FLOUNDER	0*0	0.0	0*0	1.0	0.5	130.0	1.0	0.3	65.0
ALASKA PLAICE	0*0	0.0	0.0	2*0	2.0	90.0	1*0	1.0	45*0
PACIFIC HALIBUT	0.0	0*0	0*0	0*0	0.0	0.0	0.0	0.0	0.0
Number of Species	4*0			7*0			8.0		
Mean Abundance		6*0			46.5			26.3	
Mean Weight (g)			25.0			560.o			292.5
Number of Replicates			2.0			2.0			4*0

APPENDIX TABLE E-3 (cont.)

Transect 6

Common Species Name	Station 2 3602 Freq	Mean	Mean Weight	Station 3 3603 Freq	Mean Abund	Mean Weight	Station 4 3604 Freq	Mean Abund	Mean Weight	Station 7 3607 F req	'Mean Abund	Mean Weight
empty haul	0.0	0.0	0*0	0.0	0.0	0*0	0*0	0.0	0.0	0.0	0.0	0.0
SMELT UNID	O*O	0.0	0*0	0*0	0.0	0.0	0*0	0.0	0.0	0*0	0.0	0.0
SURF SMELT	0.0	0*0	0.0	0.0	O*O	0*0	0.0	0*0	0.0	0.0	0.0	O*O
RAINBOW SMELT	0.0	0.0	0*0	1.0	0.5	20.0	0.0	0.0	0*0	0*0	0.0	O*O
EULACHON	0.0	0.0	0.0	0.0	O*O	0.0	0,0	0.0	0*0	0.0	0.0	0.0
PACIFIC COD	2*O	11*0	45.0	2.0	24.5	135.0	2*0	2R,0	92.5	2*O	8.5	35*O
WALLEYE POLLOCK	0.0	0*0	0*0	0.0	0,0	0*0	0.0	0.0	0.0	0.0	O*O	0.0
KELP GREENLING	O*O	0.0	0.0	0.0	O*O	0.0	0.0	O*O	0.0	0.0	O*O	0.0
WHITESPOTTED GREENLING	1.0	0.5	5.0	2*0	1.5	22.5	2.0	3*O	39.0	2.0	2.0	35.0
SCULPIN UNID	0.0	0*0	0.0	0*0	O*O	0*0	000	0.0	0.0	0.0	0.0	0.0
SILVERSPOT SCULPIN	O*O	0.0	0*0	0.0	O*O	0*0	0.0	0.0	O*O	2.0	1*O	11.5
THREADED SCULPIN (A)	0.0	0.0	0.0	0*0	O*O	0.0	0.0	O*O	O*O	0.0	O*O	0.0
STAGHORN SCULPIN	0.0	0.0	0.0	2*0	3.0	700,0	1.0	2.5	175*O	1.0	0.5	52.5
PLAIN SCULPIN	0.0	0.0	040	0*0	O*O	0*0	0.0	O*O	0.0	0.0	O*O	0.0
GREAT SCULPIN	0.0	0*0	0.0	0*0	O*O	0.0	0.0	O*O	0,0	O*O	O*O	0.0
SAILFIN SCULPIN	0.0	0*0	0.0	0*0	O*O	0.0	0.0	0.0	O*O	0.0	O*O	0.0
RIBBED SCULPIN	O*O	0*0	0.0	0*0	0.0	0.0	0*0	0.0	0.0	000	O*O	O*O
STURGEON POACHER	0.0	0*0	0*0	0.0	O*O	0*0	1.0	0.5	25.0	1*O	0.5	1.0
BERING POACHER	2$0	2.0	4.0	0*0	0.0	0.0	1*0	0.s	15.0	0.0	O*O	O*O
TUBENOSE POACHER	2.0	4*5	6.5	2.0	8.0	30.0	2.0	3.5	14.0	2.0	28.5	17.5
LIPARIS SF.	O*O	0.0	0*0	0*0	O*O	0.0	0*0	O*O	0.0	0.0	O*O	0.0
PACIFIC SANDFISH	0.0	0.0	0*0	0.0	O*O	0.0	0.0	0.0	0.0	O*O	O*O	0.0
SNAKE PRICKLEBACK	0.0	0.0	0.0	0*0	0.0	0.0	0*0	0.0	0.0	0.0	0.0	0.0
CRESCENT GUNNEL	O*O	0*0	0.0	0*0	O*O	0.0	0.0	0.0	0.0	1*O	O*5	10*5
PACIFIC SANDLANCE	1.0	0.5	1.5	0*0	O*O	0.0	1.0	5.5	45.0	2.0	1.0	3.0
BUTTER SOLE	1.0	1.0	125.0	0*0	0.0	0*0	0.0	0.0	000	0.0	O*O	O*O
ROCK SOLE	2.0	5.0	165.0	2*0	1*O	77.5	2*0	6*O	140.0	2.0	4.5	82.5
YELLOWFIN SOLE	2*O	44*5	1750,0	2.0	221*O	16100.0	2.0	26.0	1350.0	2.0	4.5	80.0
LONGHEAD DAB	0.0	0.0	0*0	0.0	0.0	0.0	0.0	0.0	O*O	0.0	0,0	0.0
ARCTIC FLOUNDER	0,0	0.0	0*0	0.0	O*O	0.0	0.0	0.0	0.0	0.0	O*O	O*O
STARRY FLOUNDER	2.0	1*0	712.5	2.0	2.5	1175,0	1.0	1.5	600,0	0.0	0.0	0.0
ALASKA PLAICE	1.0	1.0	300 .o	0.0	O*O	0.0	2.0	3.5	82.5	2.0	9.0	27.5
PACIFIC HALIBUT	2.0	2.0	15.5	0*0	0.0	0.0	0.0	0.0	0.0	2.0	1.5	27.5
Number of Species	11.0			8.0			11.0			12.0		
Mean Abundance		73.0			262.0			80.5			62.0	
Mean Weight (g)			3130.0			18260.0			2578.0			383.5
Number of Replicates			2.0			2.0			2.0			2.0

APPENDIX TABLE E-3 (cont.)

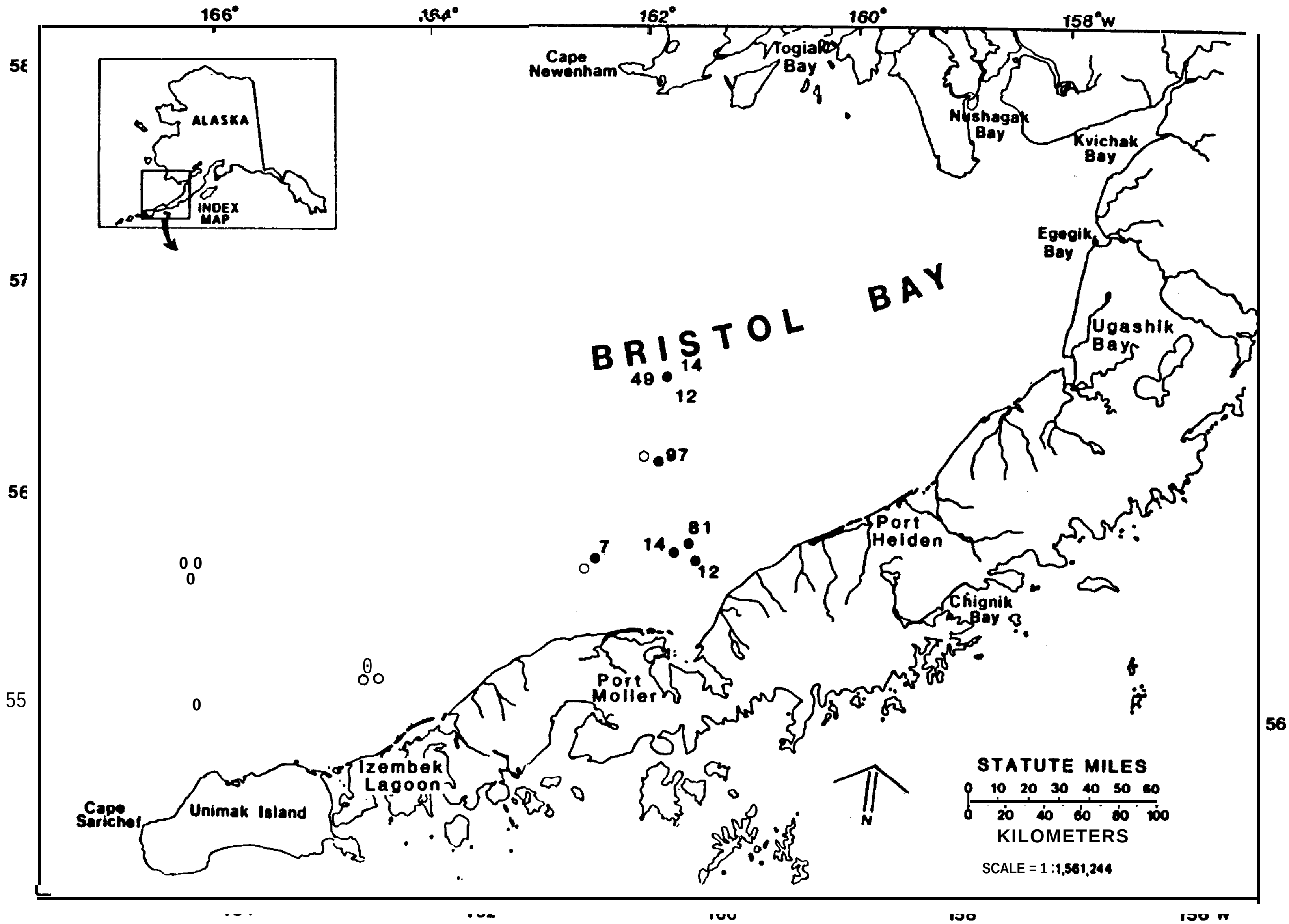
Transect 6 (cent)

Common Species Name	3608 F req	Station 8 Mean Abund	Mean Weight	3609 F req	Station 9 Mean Abund	Mean Weight	Transect Summary F req	Mean Abund	Mean Weight
Empty haul	0*0	0*0	0*0	0*0	0.0	0*0	0*0	0*0	0.0
SMELT UNID	0.0	0.0	0.0	0.0	0*0	0*0	0.0	0*0	0*0
SURF SMELT	0*0	0.0	0*0	1*0	0.5	0.5	1*0	0.1	0.1
RAINBOW SMELT	0.0	0.0	0.0	000	0*0	0,0	1.0	0.1	3*3
EULACHON	0.0	0*0	0.0	0.0	0.0	0*0	0*0	0.0	0*0
PACIFIC COD	2.0	4*0	17.5	2.0	75.0	195*0	6.0	25.2	86.7
WALLEYE POLLOCK	0.0	0*0	0*0	0.0	0,0	0,0	0.0	0.0	0.0
KELP GREENLING	I*0	0.5	1.5	2*0	1.0	16,0	2.0	0*3	2.9
WHITESPOTTED GREENLING	1.0	0.5	5.0	2*0	5.5	92.5	6.0	2.2	33.2
SCULPIN UNID	0*0	0*0	0.0	0.0	0*0	0.0	0.0	0*0	0*0
SILVERSPOT SCULPIN	0.0	0*0	0.0	0.0	0.0	0,0	1.0	0*2	1.9
THREADED SCULPIN (A)	0*0	0.0	0.0	0.0	0.0	0.0	0*0	0.0	0.0
STAGHORN SCULPIN	0.0	0*0	0*0	2*0	2.5	132.5	4.0	1.4	176.7
PLAIN SCULPIN	0.0	0*0	0*0	2*0	1*0	2,5	1.0	0.2	0*4
GREAT SCULPIN	0.0	0.0	0*0	1.0	0*5	0*5	1.0	0.1	0.1
SAILFIN SCULPIN	0*0	0*0	0*0	0,0	0*0	0*0	0*0	0.0	0.0
RIBBED SCULPIN	0.0	0*0	0.0	0.0	0.0	0.0	0,0	0*0	0.0
STURGEON POACHER	0.0	0*0	0*0	2.0	5.5	47*5	3,0	1*1	12.3
BERING POACHER	0*0	0*0	0*0	0.0	0*0	0.0	2.0	0*4	3.2
TUBENOSE POACHER	1*0	0.s	0.5	1*0	6.0	6.0	6.0	8.5	12.4
LIPARIS SP.	0.0	0.0	0.0	0.0	0*0	0*0	0,0	0.0	0.0
PACIFIC SANDFISH	0.0	0.0	0*0	2.0	1.0	5.0	1*0	0.2	0.8
SNAKE PRICKLEBACK	0*0	0*0	0.0	2*0	1.5	21.0	1.0	0.3	3.5
CRESCENT GUNNEL	0*0	0.0	0.0	1.0	0.5	19*0	2*0	0.2	4*9
PACIFIC SANDLANCE	2.0	452.0	742.5	1*0	1.5	1.5	5.0	76.8	132.3
BUTTER SOLE	0*0	0*0	0.0	0,0	0*0	0*0	1.0	0.2	20.8
ROCK SOLE	1*0	1*0	10.0	2*0	1000	80,0	6.0	4.6	92.5
YELLOWFIN SOLE	2.0	2*0	49.5	2.0	18.0	507,5	6.0	52.7	3306.2
LONGHEAD DAB	0.0	0*0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ARCTIC FLOUNDER	0*0	0*0	0*0	0*0	0*0	0*0	0.0	0.0	0.0
STARRY FLOUNDER	1*0	0.5	225.0	1.0	1*0	412.5	5.0	1*1	520.8
ALASKA PLAICE	0.0	0.0	0.0	2.0	3.5	4.0	4*0	2.8	69.0
PACIFIC HALIBUT	1.0	0*5	25.0	2.0	4.5	155.0	4*0	1.4	37,2
Number of Species	9.0			18*0			22.0		
Mean Abundance		461 .S			139.0			179.7	
Mean Weight (g)			1076.5			1698.S			4521.1
Number of Replicates			2*0			2*0			12.0

APPENDIX F

SPECIES BREAKDOWN OF 1962 THROUGH 1968 JUVENILE SALMON PURSE SEINE CATCHES

(Source: Data from Hartt and Dell 1978)

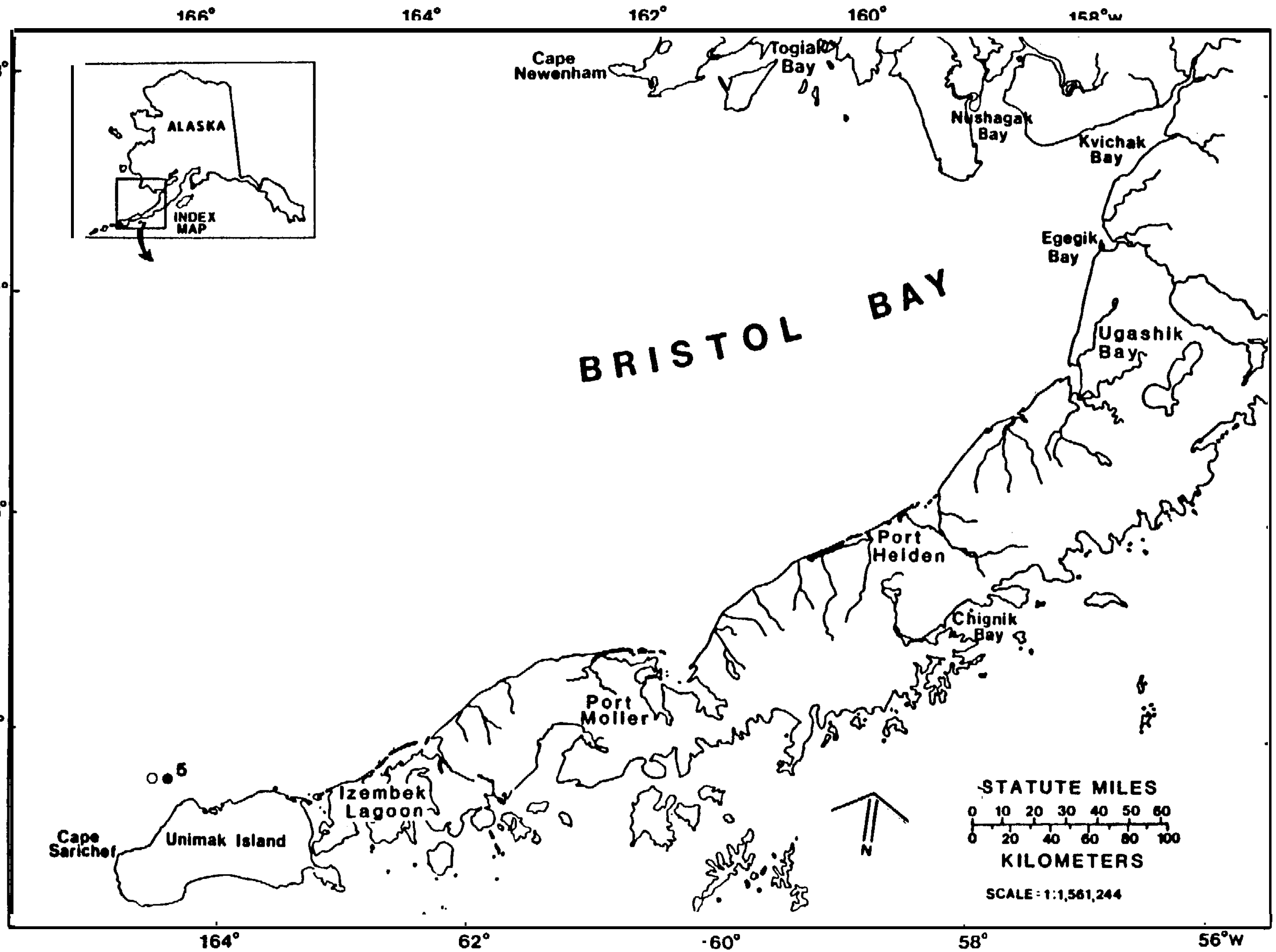


KEY:
O None of this species taken

Juvenile Sockeye Salmon Purse Seine Catch July, 1962

Figure F-1

Dames & Moore

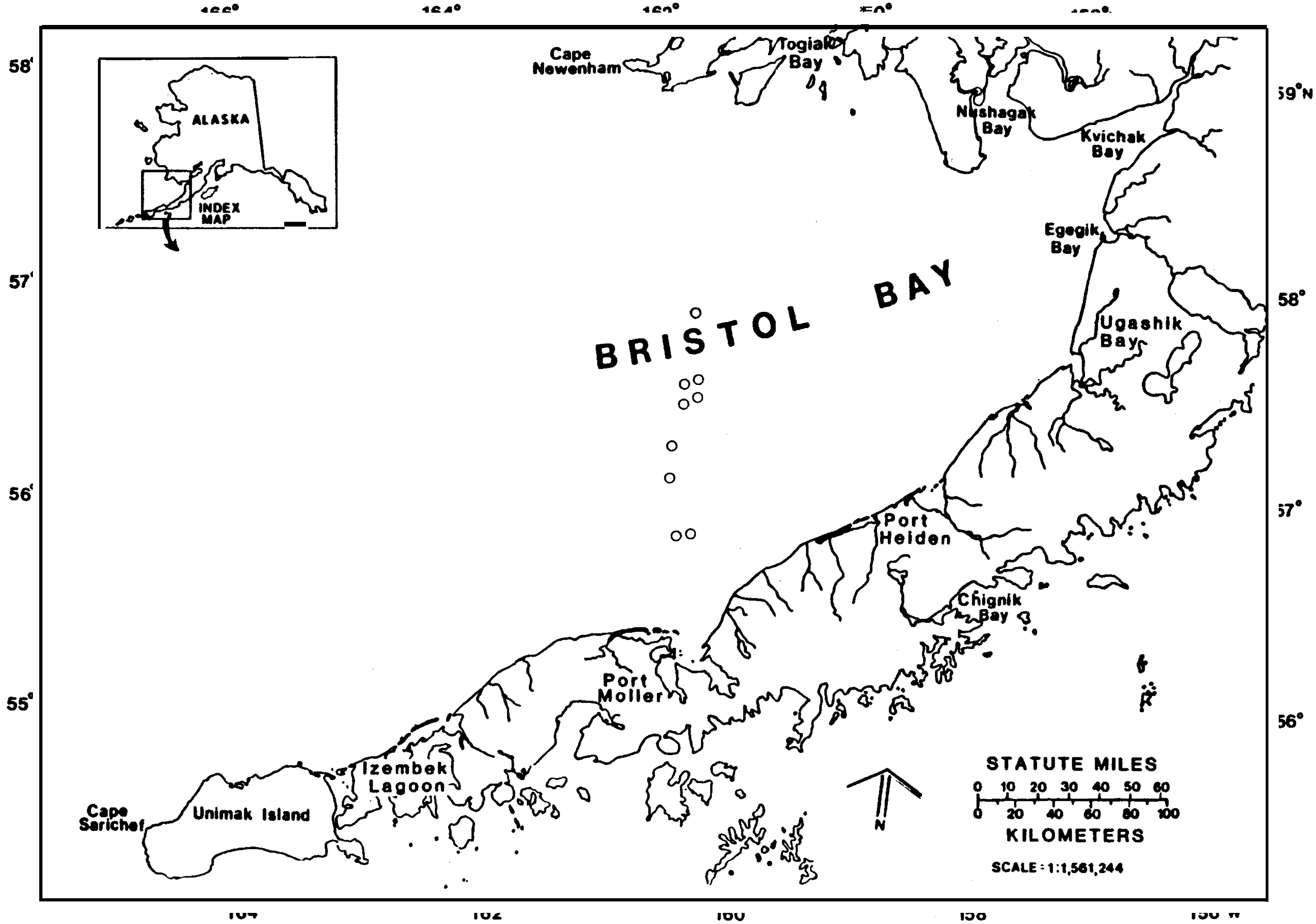


Juvenile Sockeye Salmon Purse Seine Catch
August, 1962

KEY:
o None of this species taken

Dames & Moore

Figure F-2

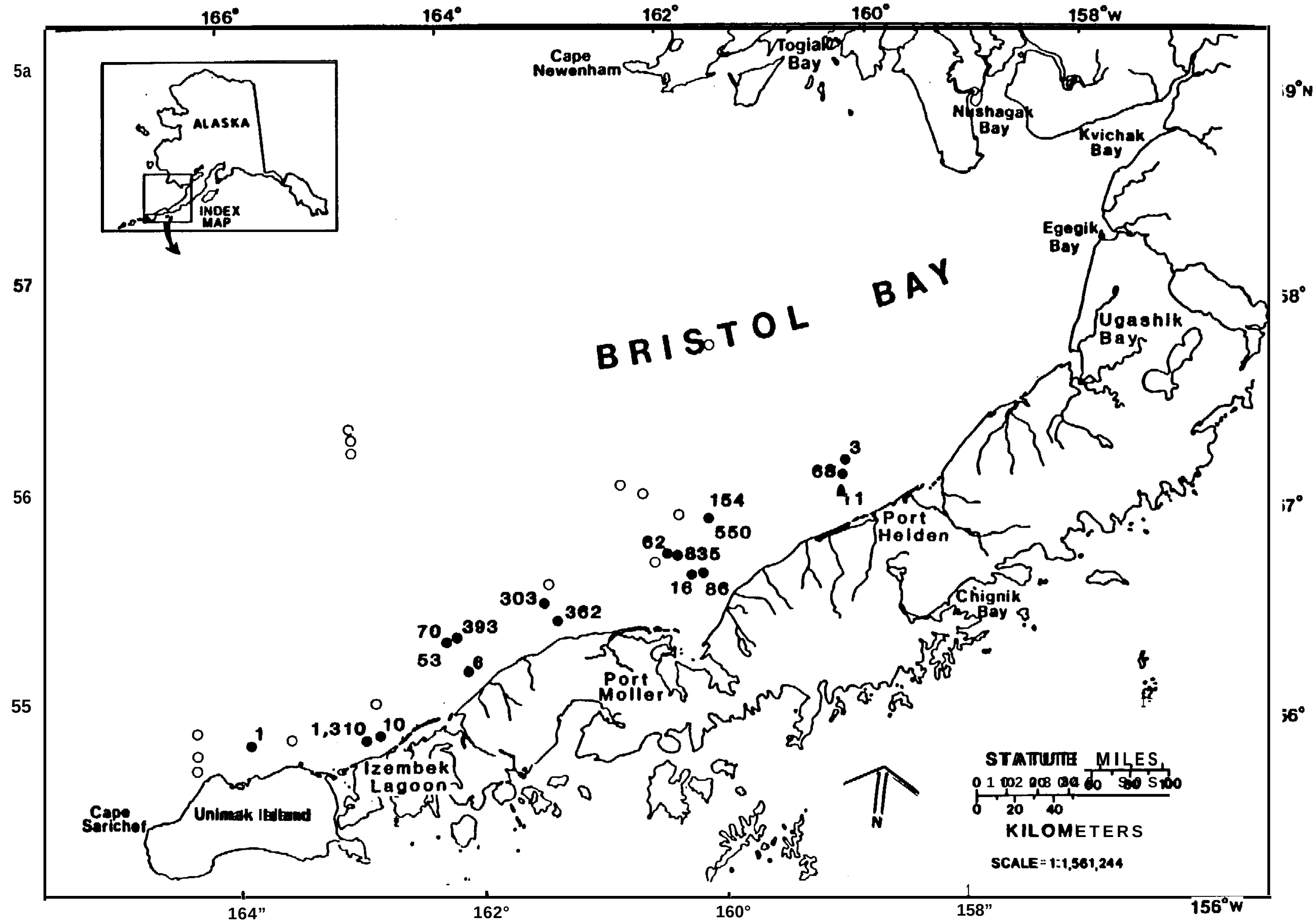


KEY:
○ None of this species taken

Juvenile Sockeye Salmon Purse Seine Catch June, 1966

Figure F-3

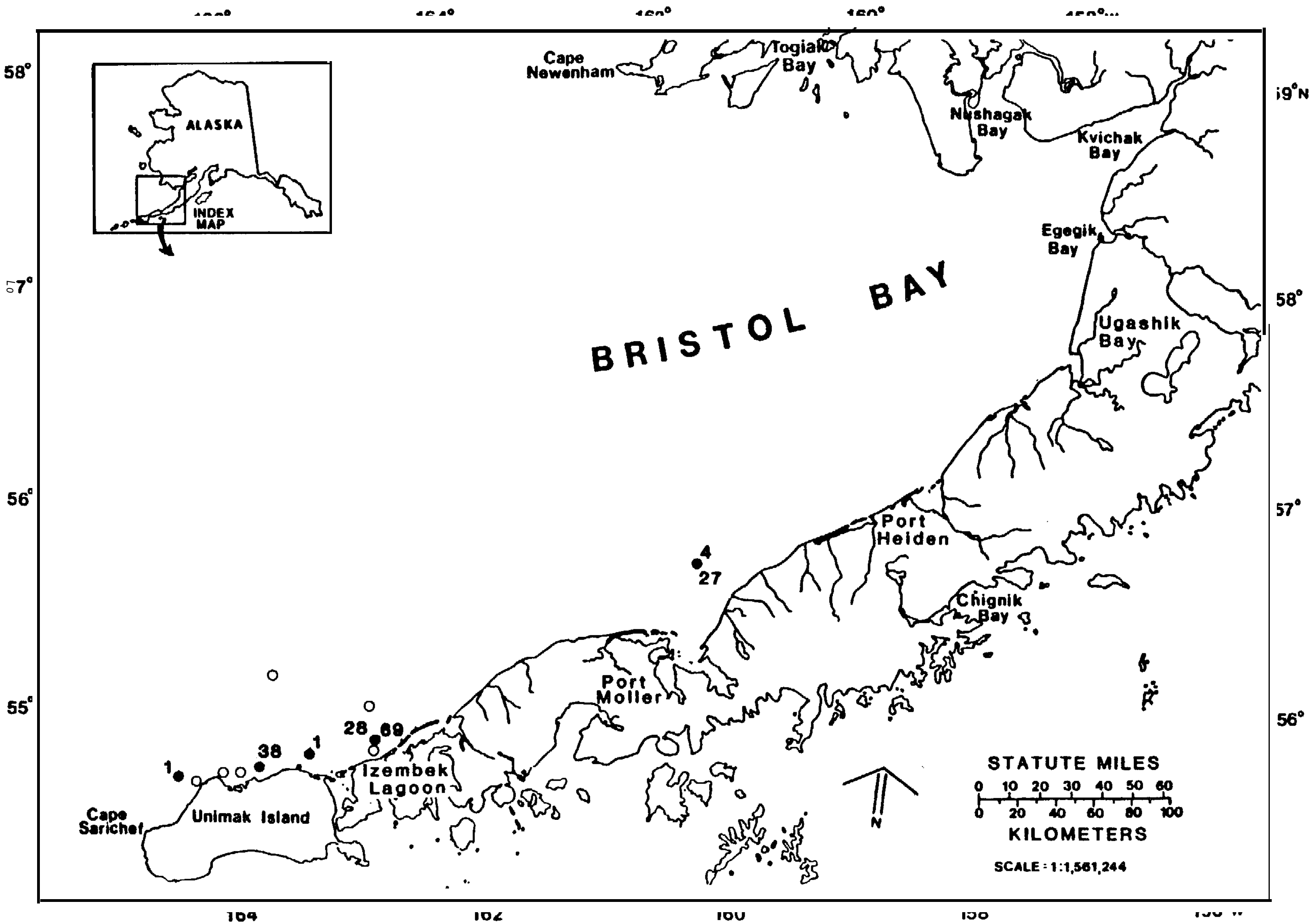
Dames & Moore



KEY:
O None of **this** species **taken**

Juvenile Sockeye Salmon Purse Seine Catch July, 1966

Dames & Moore



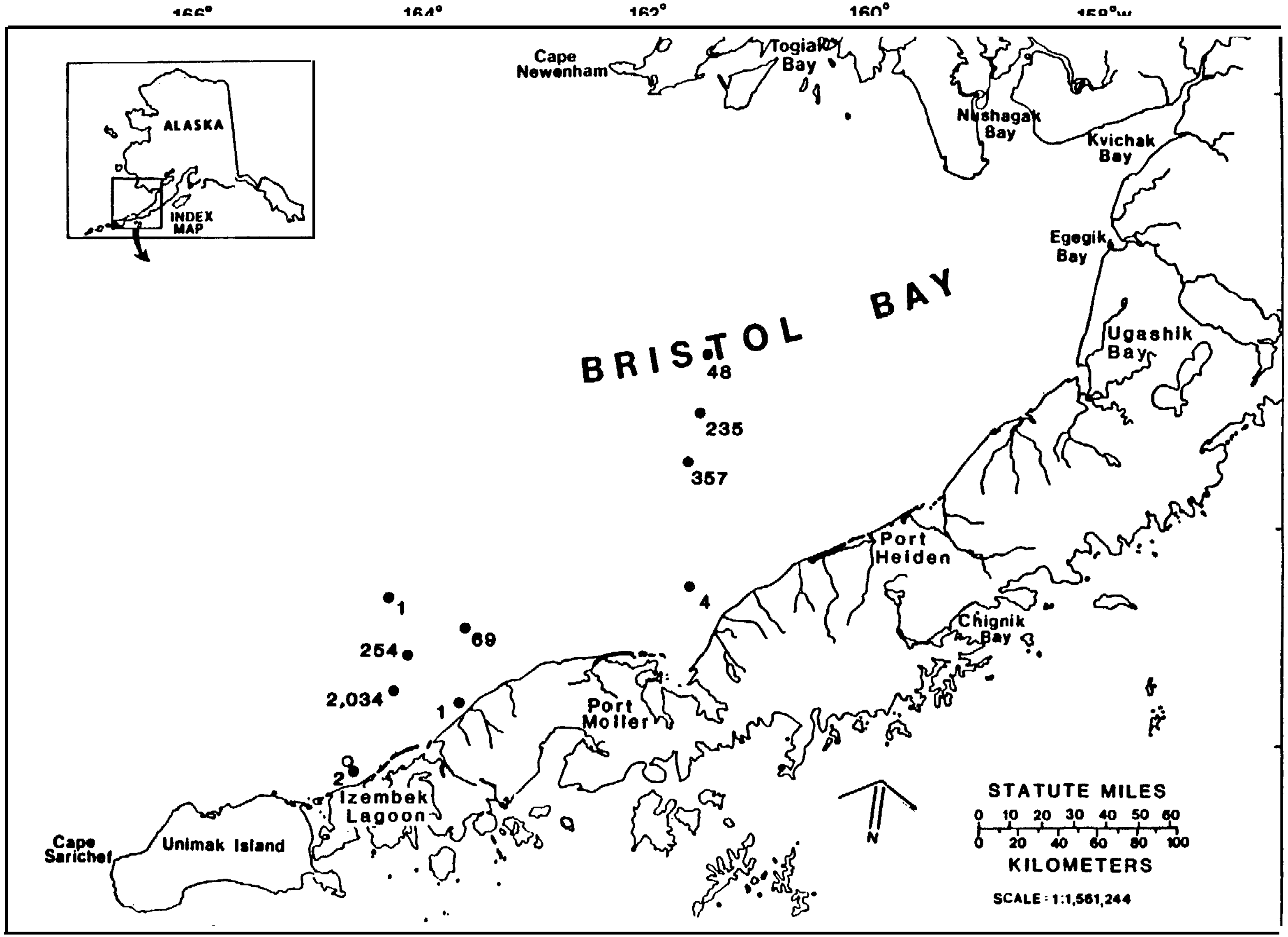
KEY:
○ None of this species taken

Juvenile Sockeye Salmon Purse Seine Catch August, 1966

Figure F-5

Dames & Moore

318

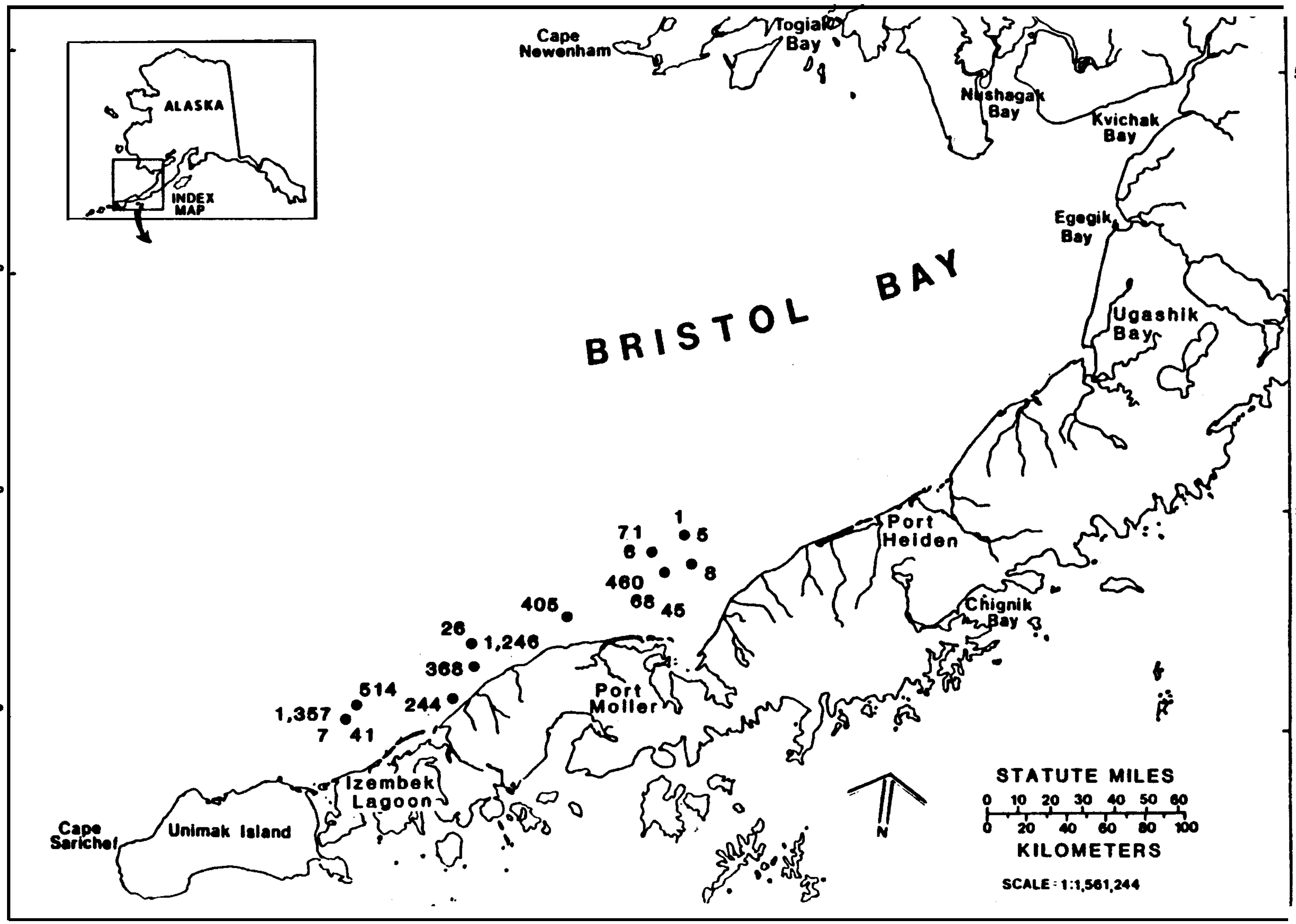


KEY:
○ None of this species taken

Juvenile Sockeye Salmon Purse Seine Catch September, 1967

Figure F-6

Dames & Moore

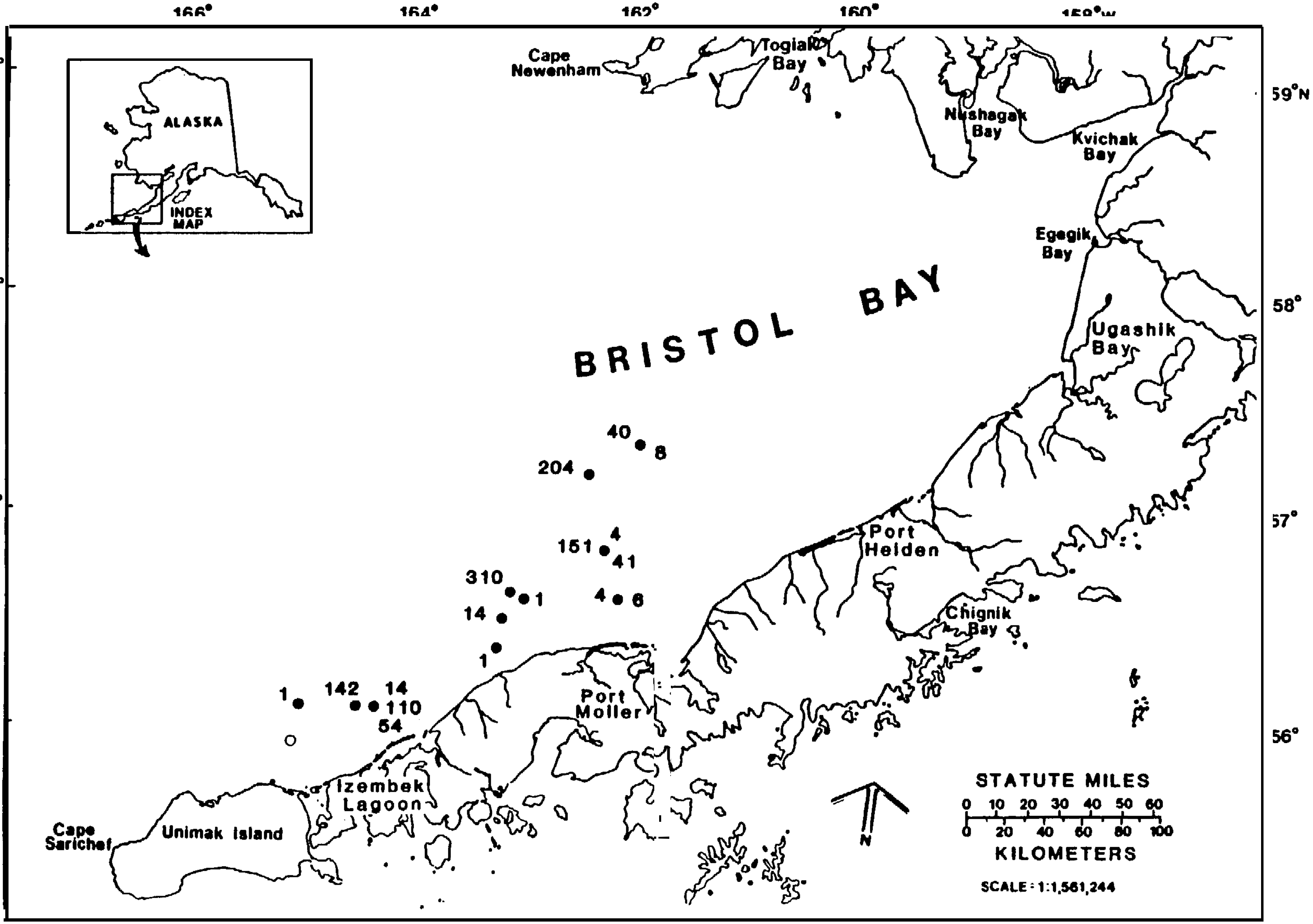


KEY:
○ None ○ this species taken

Juvenile Sockeye Salmon Purse Seine Catch
August, 1968

Figure F-7

Dames & Moore

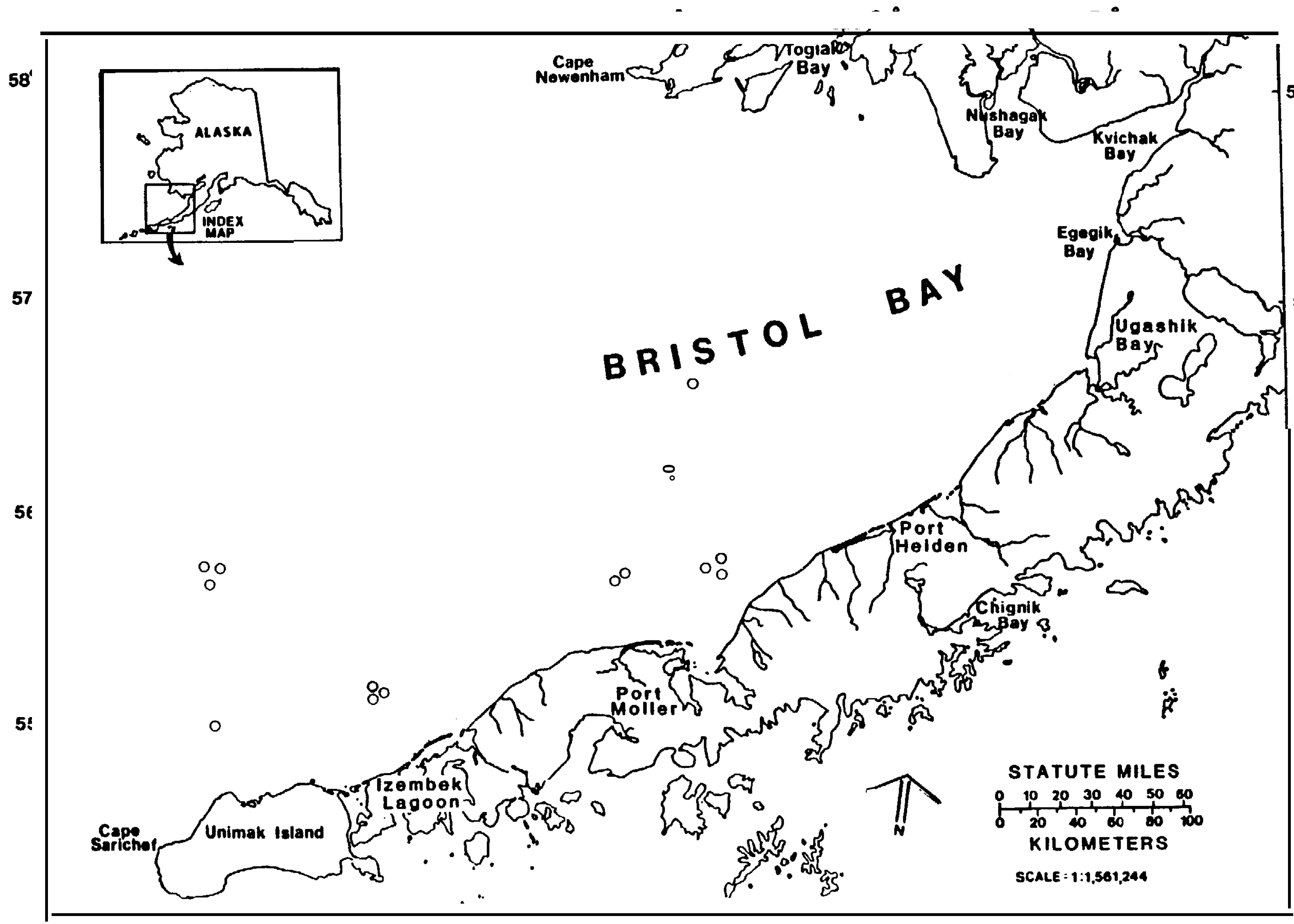


KEY:
○ None of this species taken

Juvenile Sockeye
Salmon Purse Seine Catch
September, 1968

Dames & Moore

Figure F-8



KEY:
○ None of this species taken

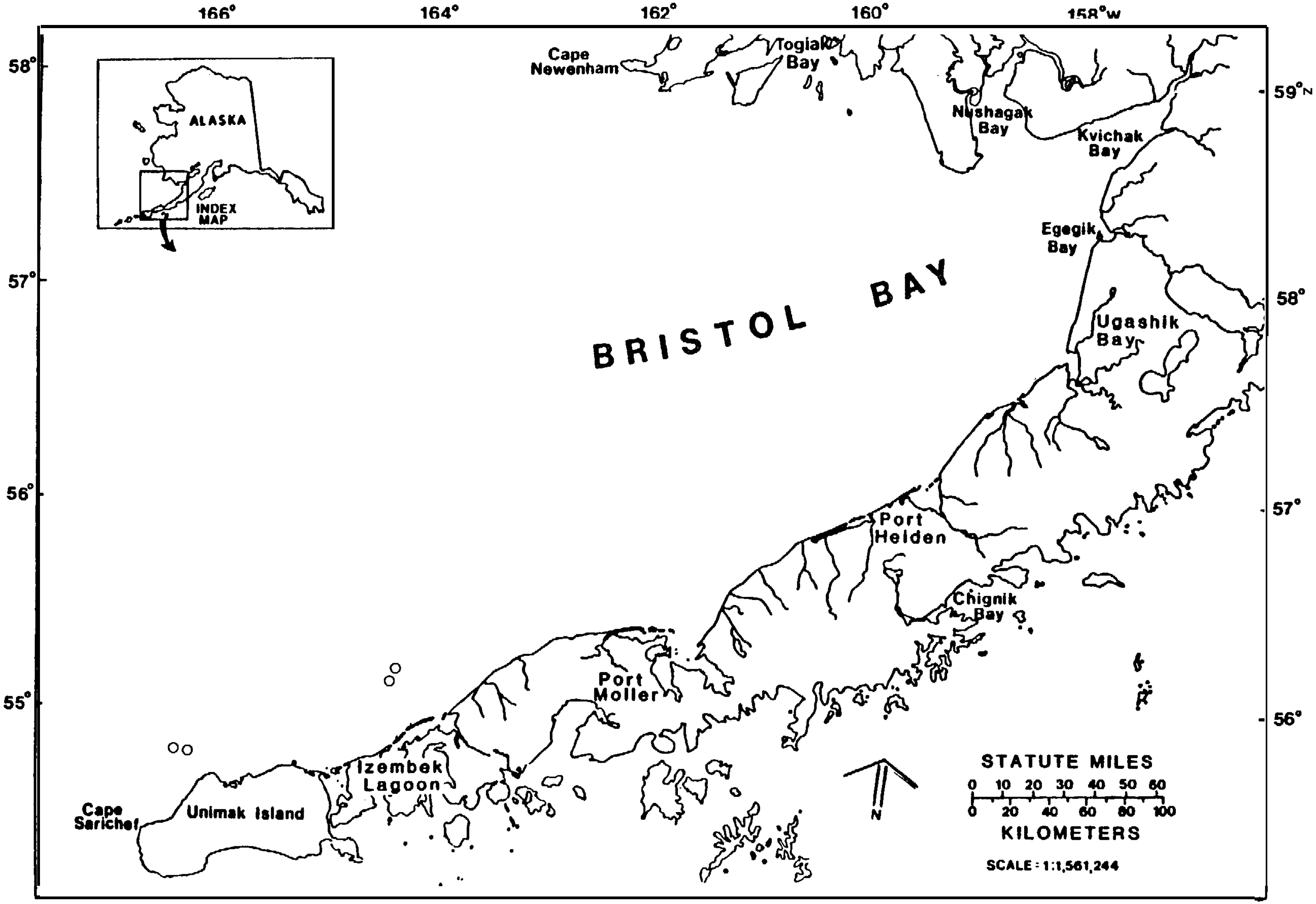
Juvenile Chum Salmon Purse Seine Catch
July, 1962

Figure F-9

Dames & Moore

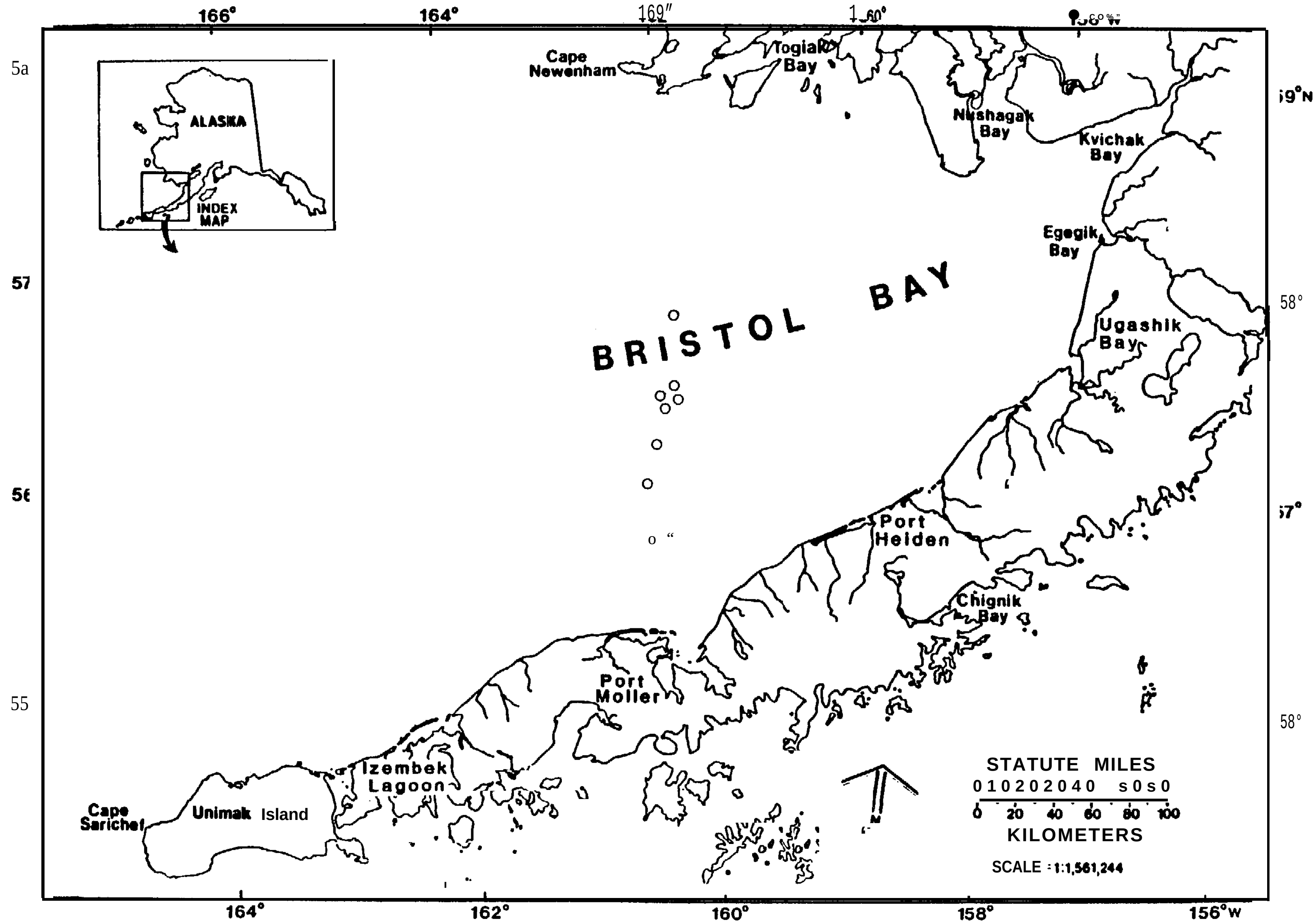
Figure F10

Dames & Moore



KEY:
○ None of this species taken

Juvenile Chum
Salmon Purse S ine Catch
August, 1962



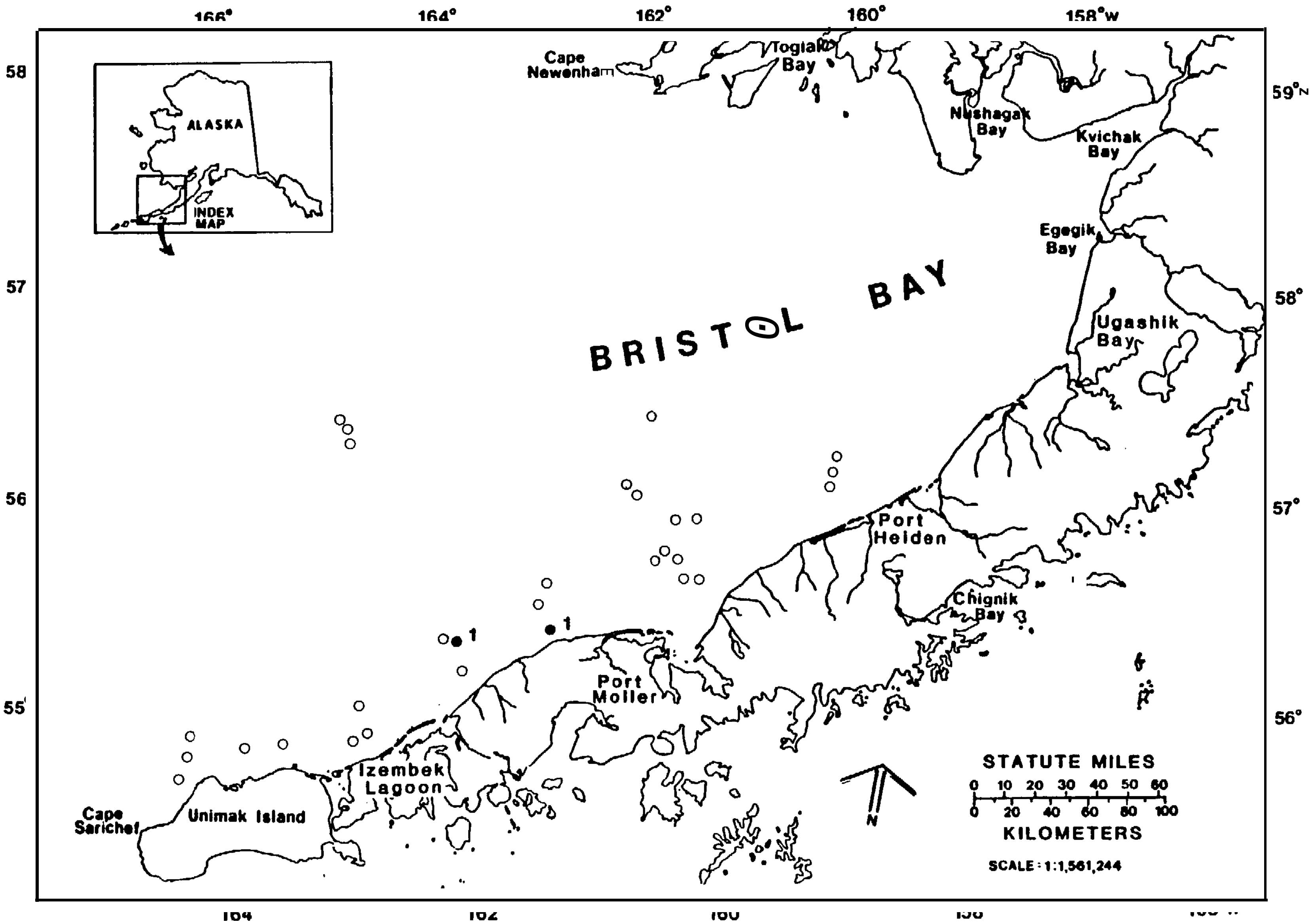
KEY:
O None of this species taken

Juvenile Chum Salmon Purse Seine Catch June, 1966

324

Figure

Dames & Moore

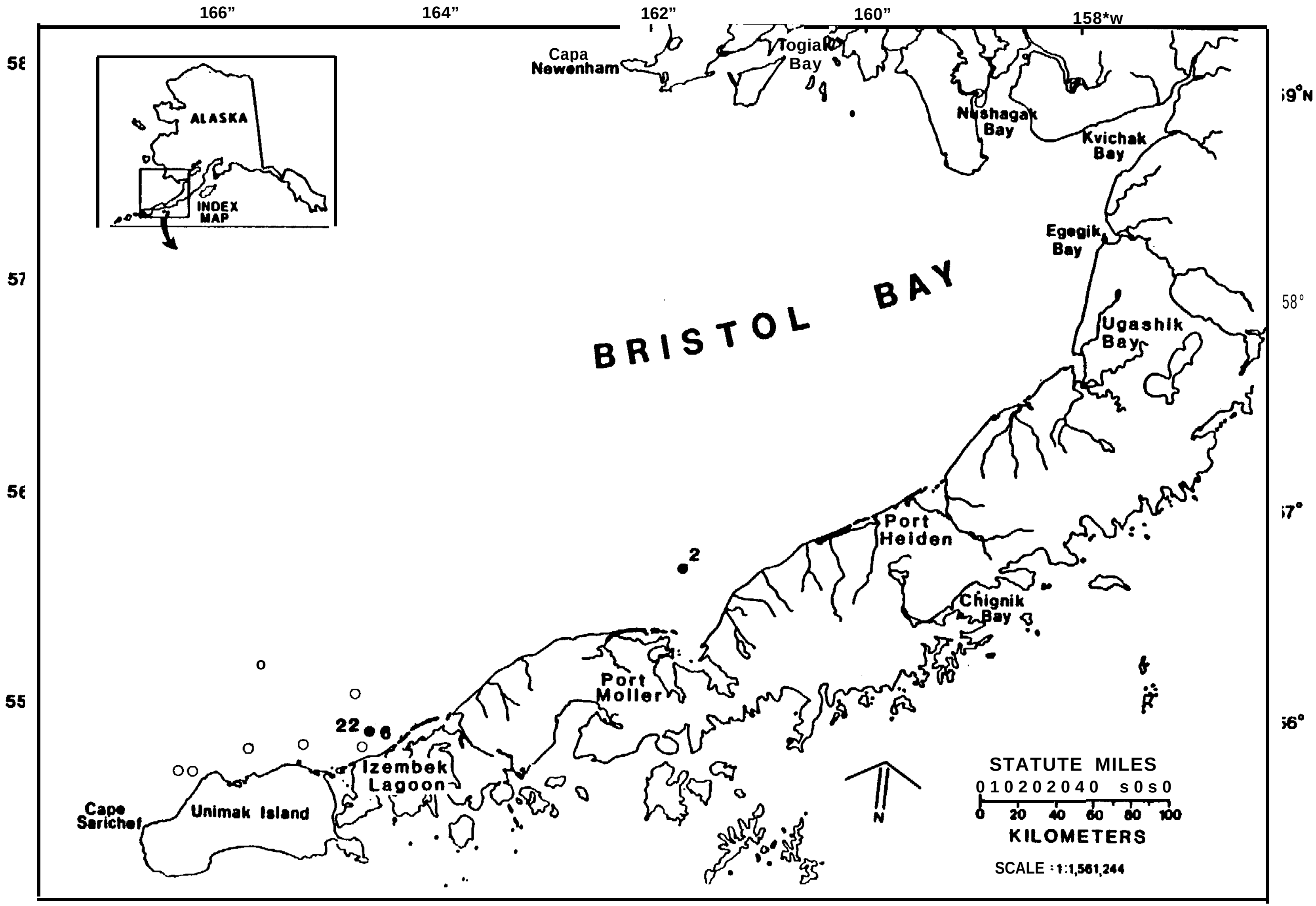


KEY:
○ None of this species taken

Juvenile Chum Salmon Purse Seine Catch July, 1966

Figure F-12

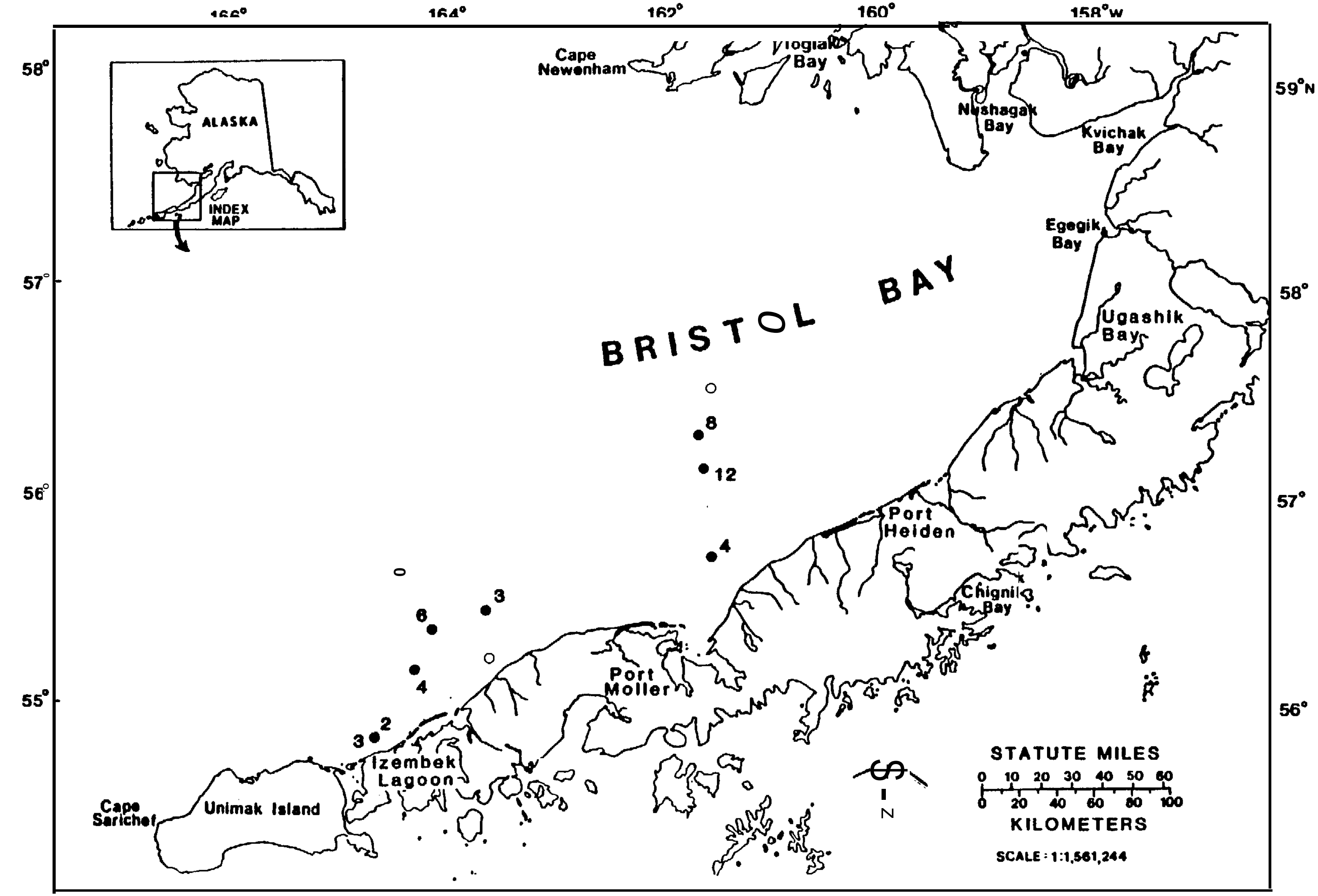
Dames & **Moore**



KEY:
O None of this species taken

Juvenile Chum Salmon Purse Seine Catch August, 1966

Dam & M 9 9 3



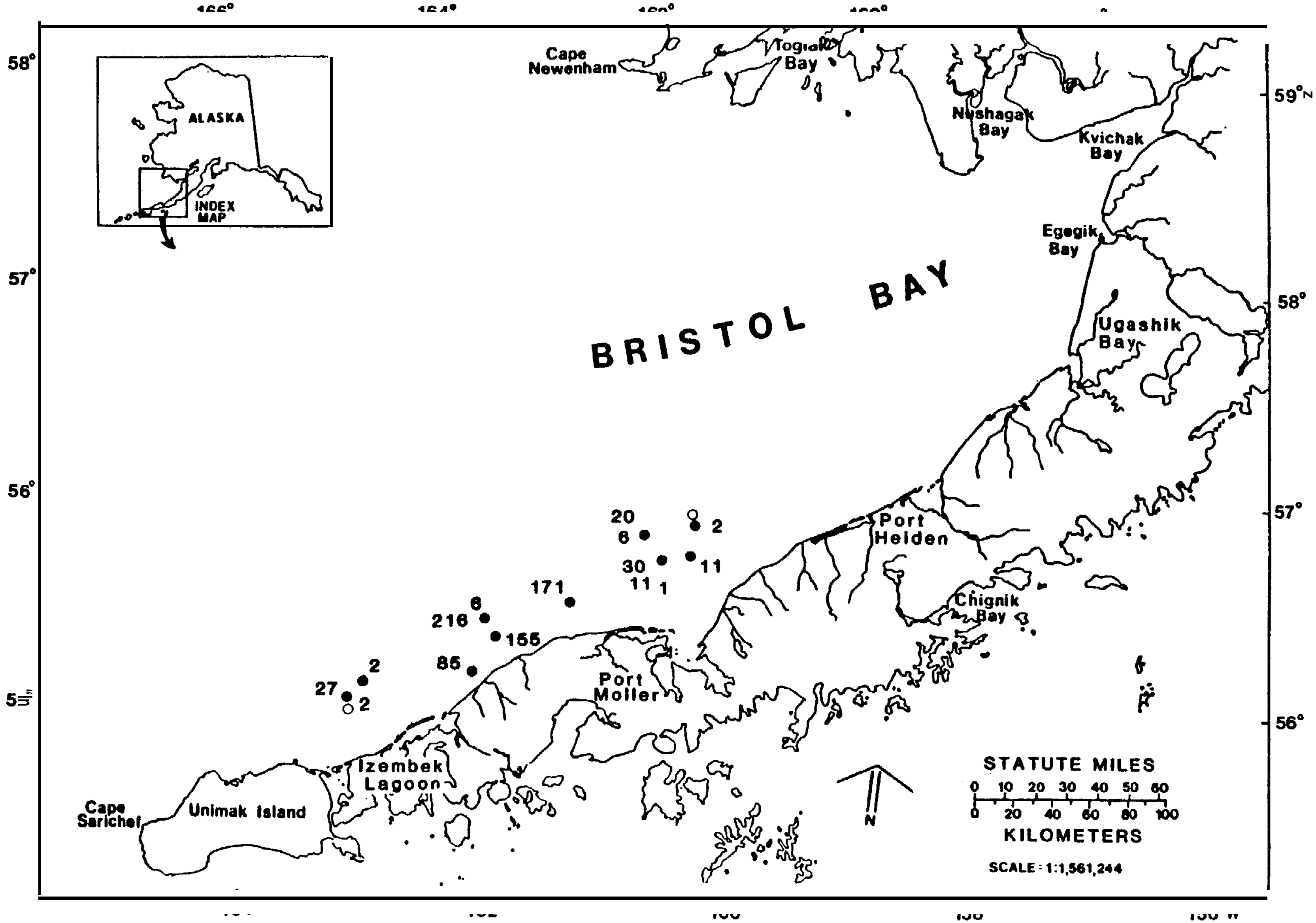
KEY:
○ None of this species taken

Juvenile Chum
Salmon Purse Seine Catch
September, 1967

Figure F-14

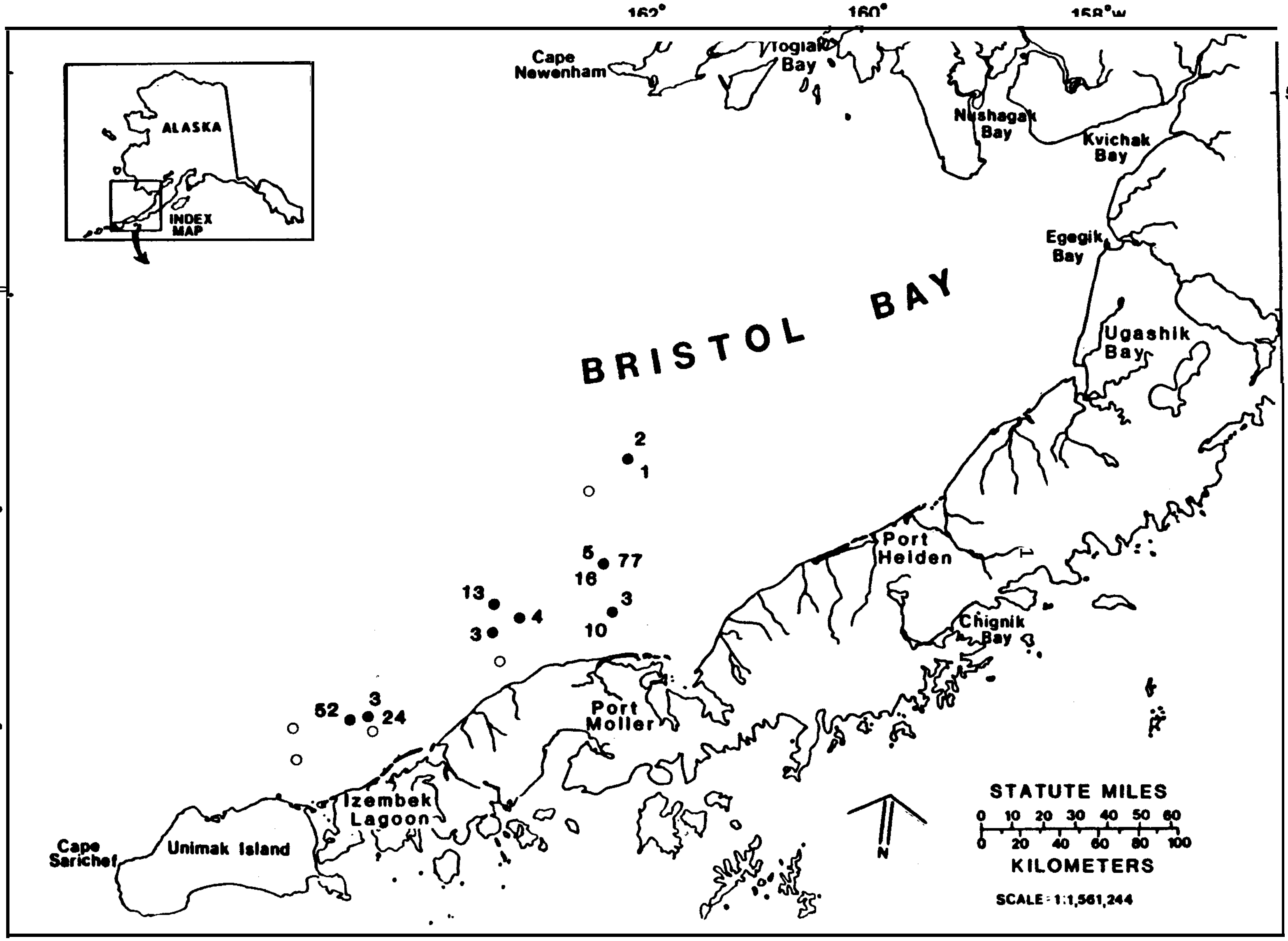
Dames & Moore

Figure F-15



KEY:
○ None of this species taken

Juvenile Chum Salmon Purse Seine Catch
August, 1968

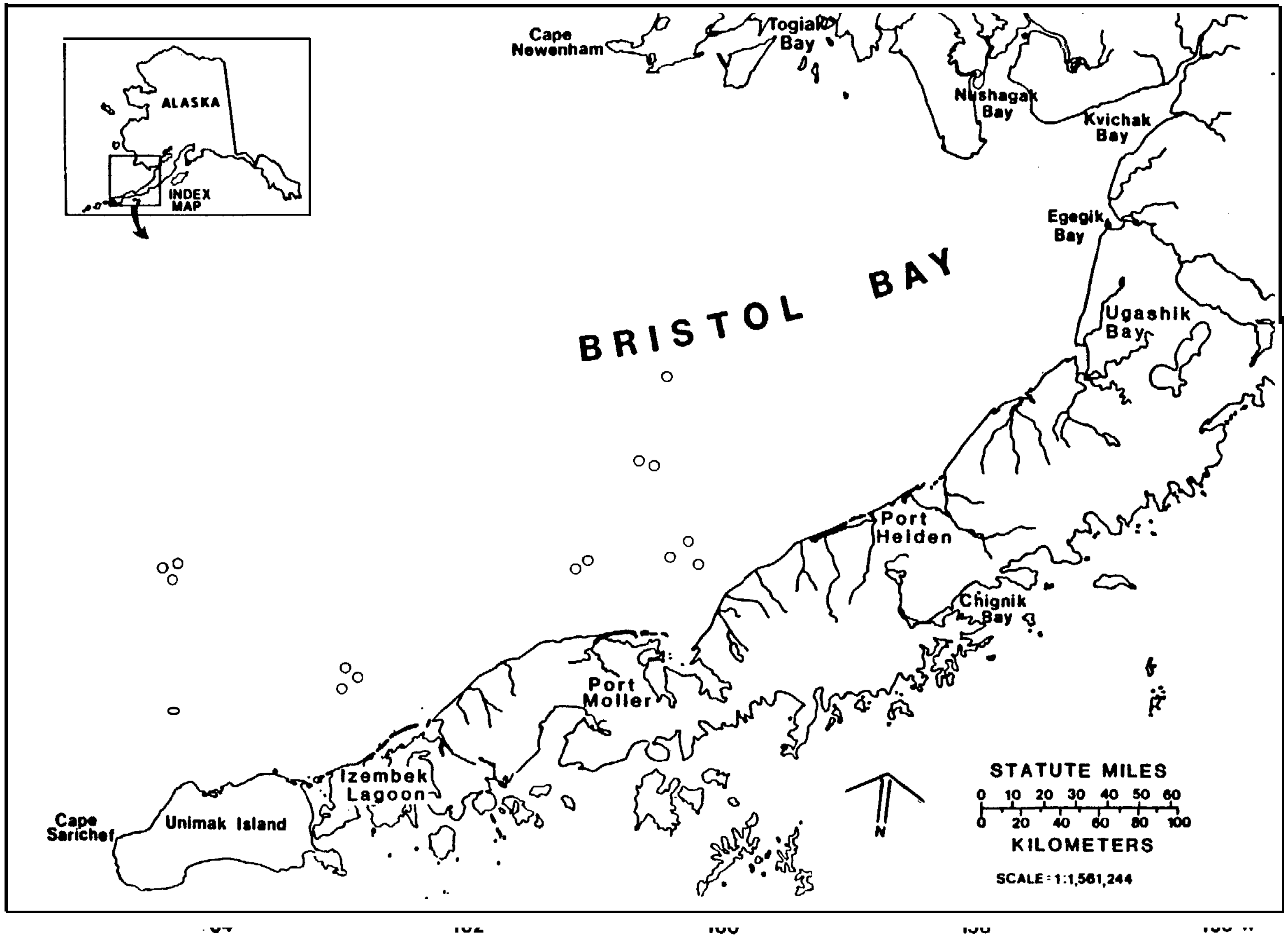


KEY:
○ None of this species taken

Juvenile Chum
Salmon Purse Seine Catch
September, 1968

Figure 6

Dames & Moore

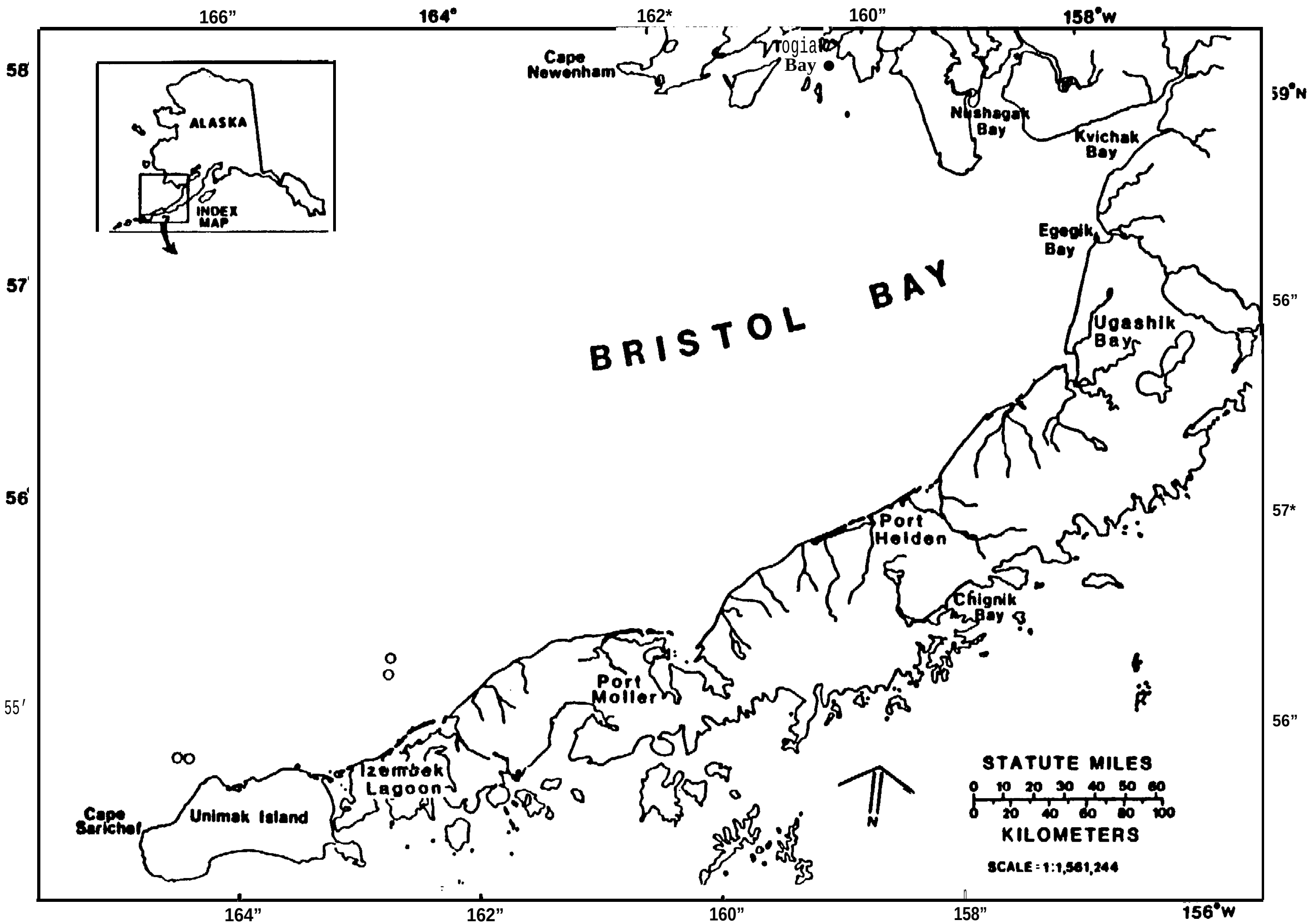


KEY:
○ None of this species taken

Juvenile Coho
Salmon Purse Seine Catch
July, 1962

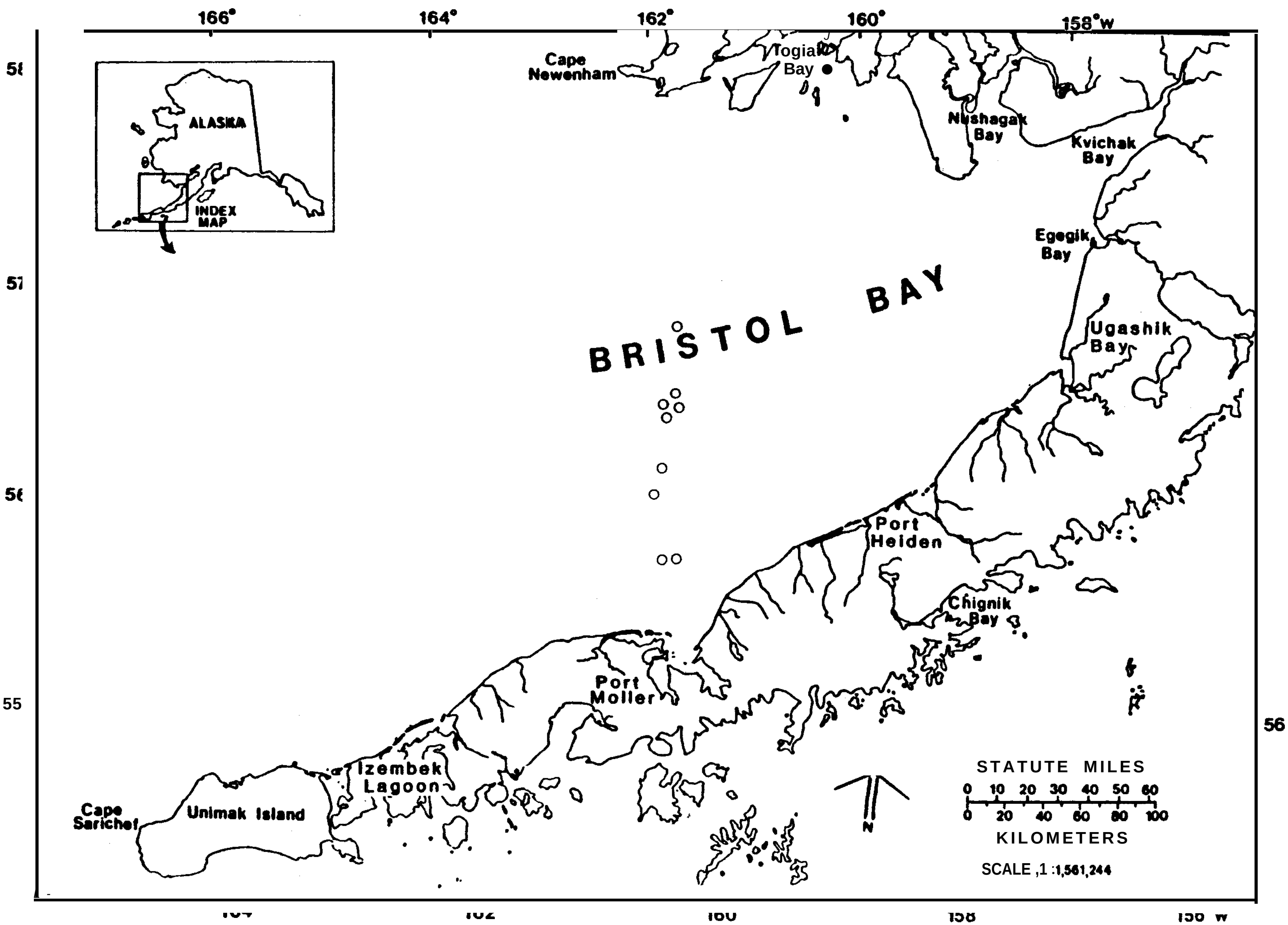
Dames & Moore

Figure F-1 7



KEY:
o None of this ● POCI09 taken

Juvenile Coho Salmon Purse Seine Catch
August, 1962



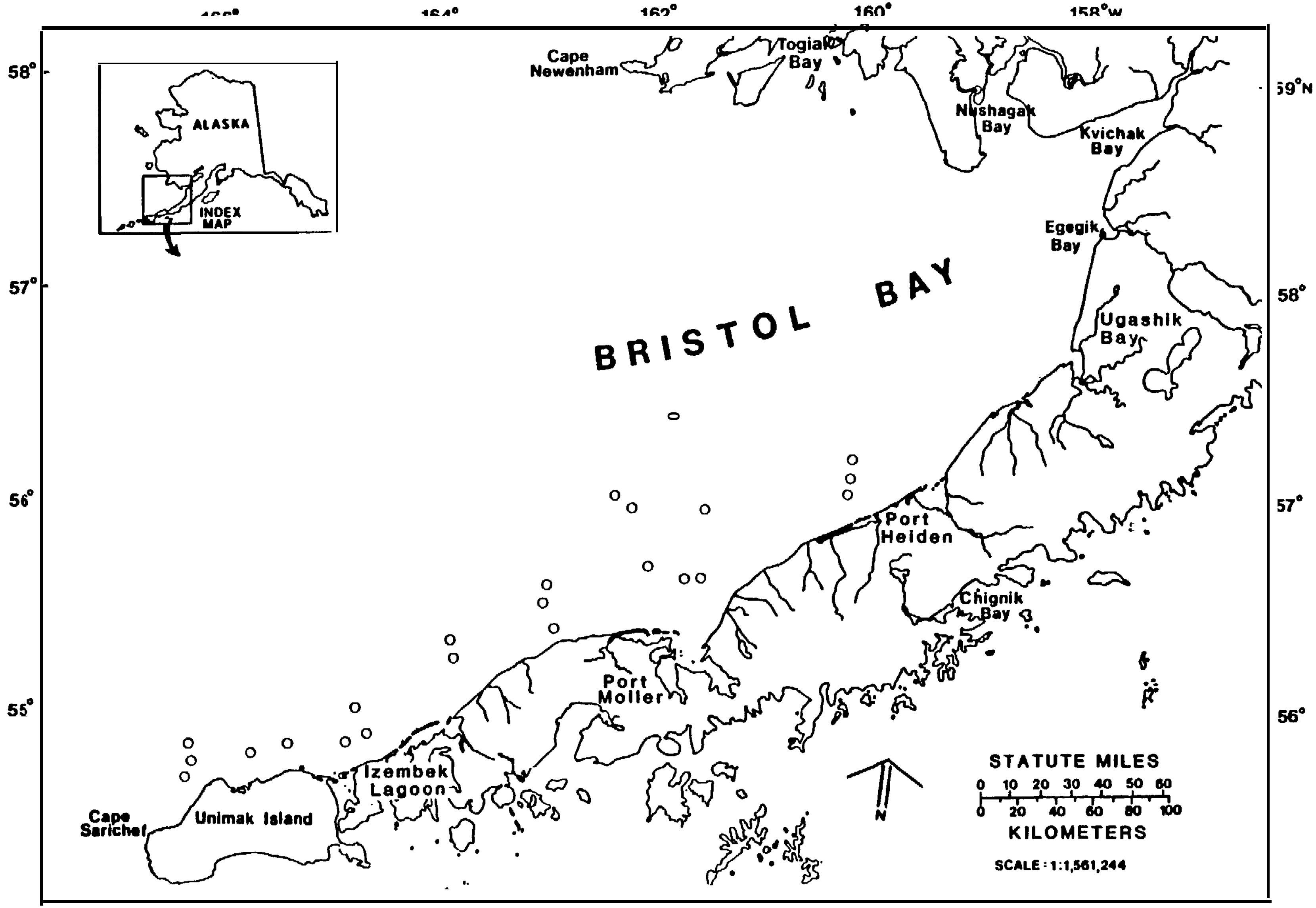
4

Juvenile Coho Salmon Purse Seine Catch June, 1966

KEY:
O None of this species taken

Dames & Moore

Figure F-19

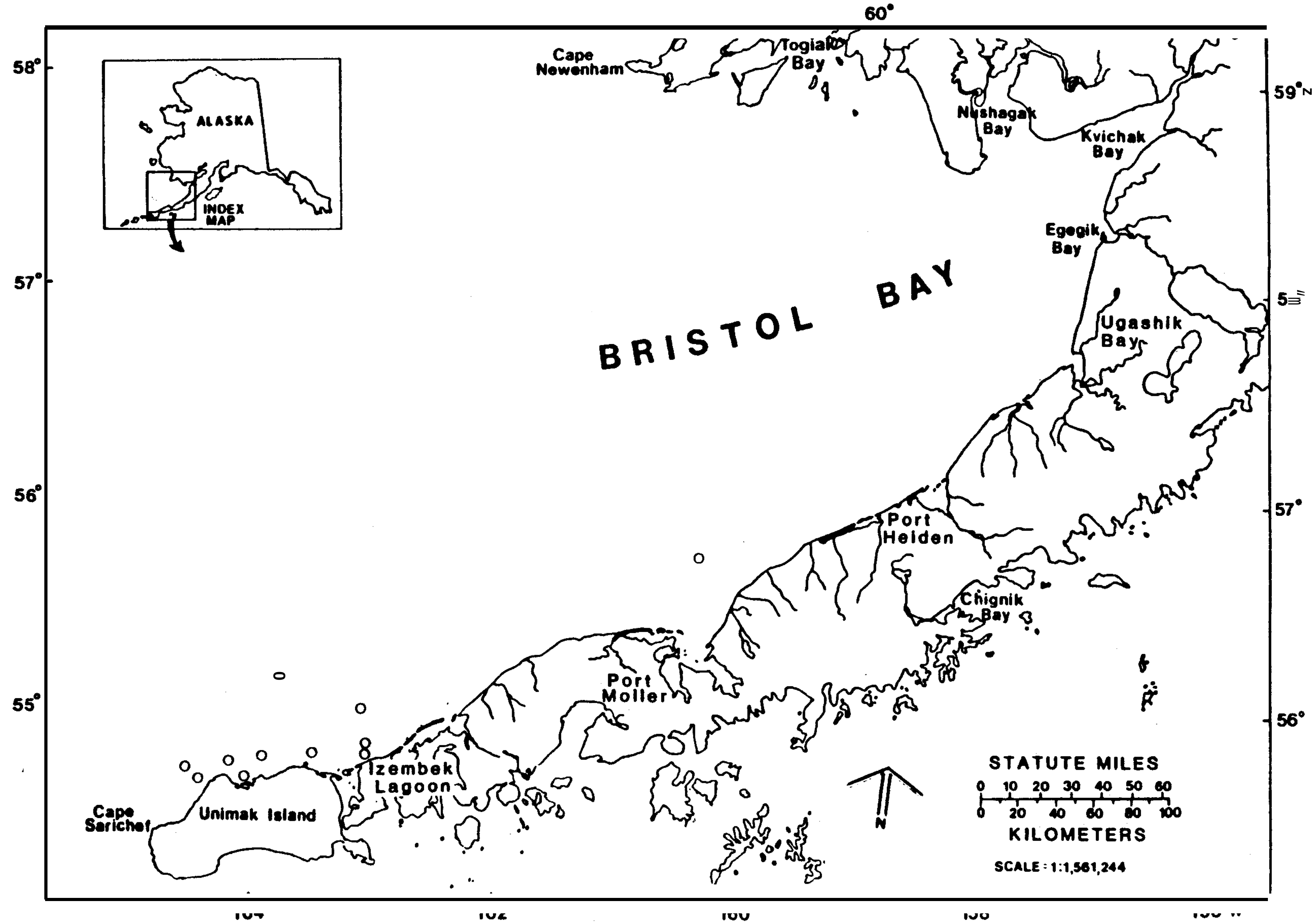


KEY:
○ None of this species taken

Juvenile Coho Salmon Purse Seine Catch July, 1966

Dames & Moore

Figure F-20

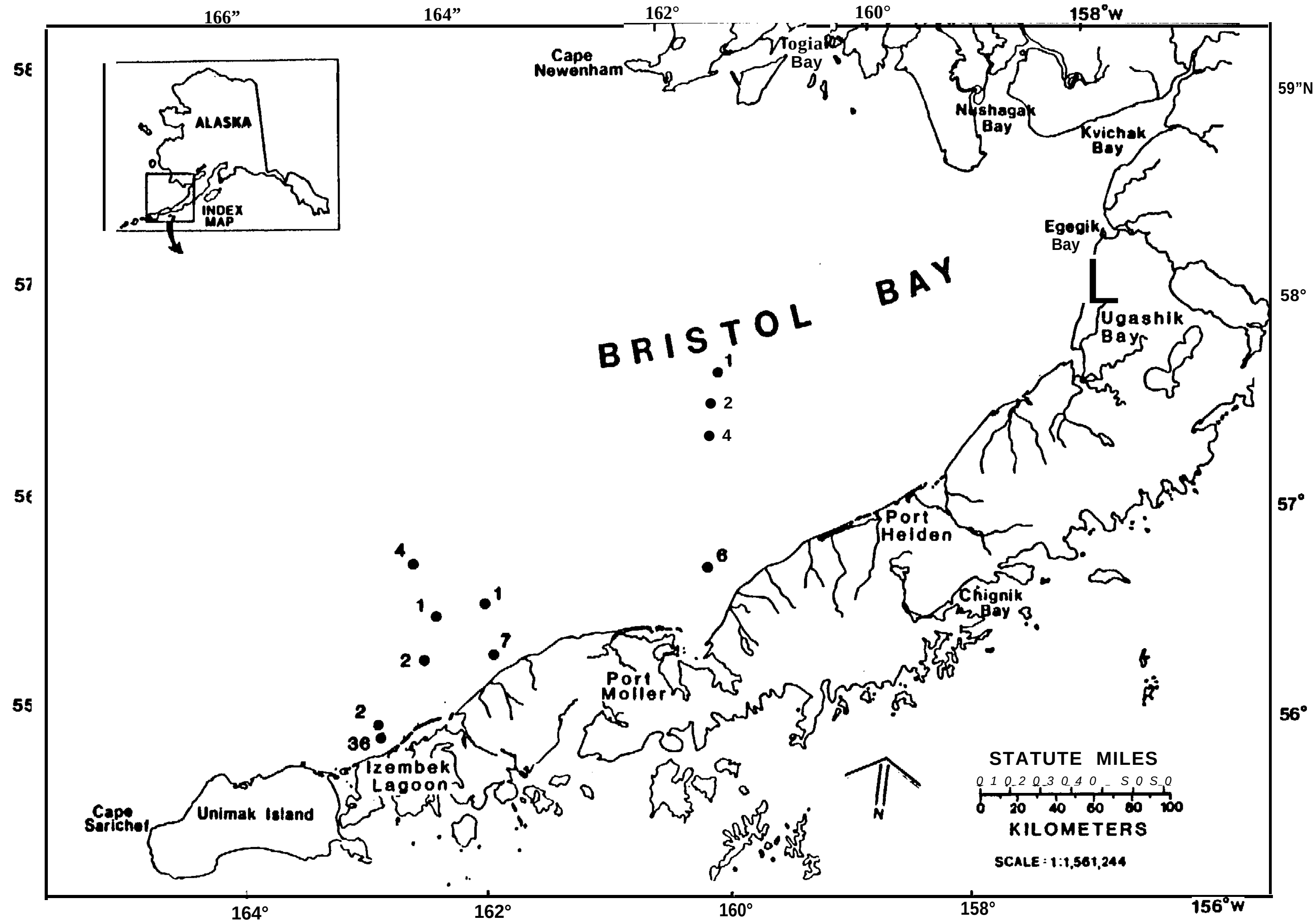


KEY:
○ None of this species taken

Juvenile Coho Salmon Purse Seine Catch August, 1966

Figure F-21

Dames & Moore

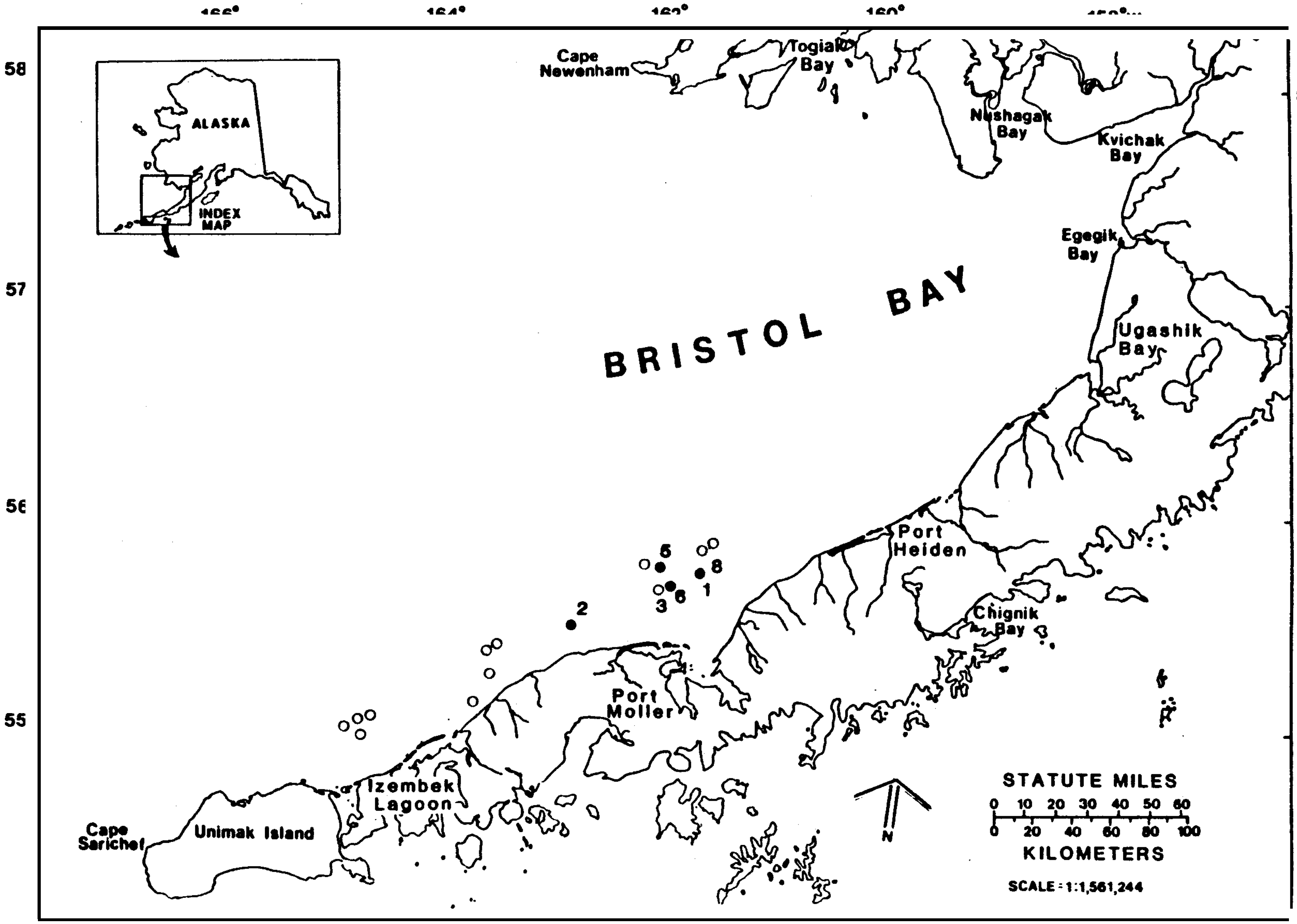


KEY:
o None of this species taken

Juvenile Coho Salmon Purse Seine Catch September, 1967

Dames & Moore

Figure F-22

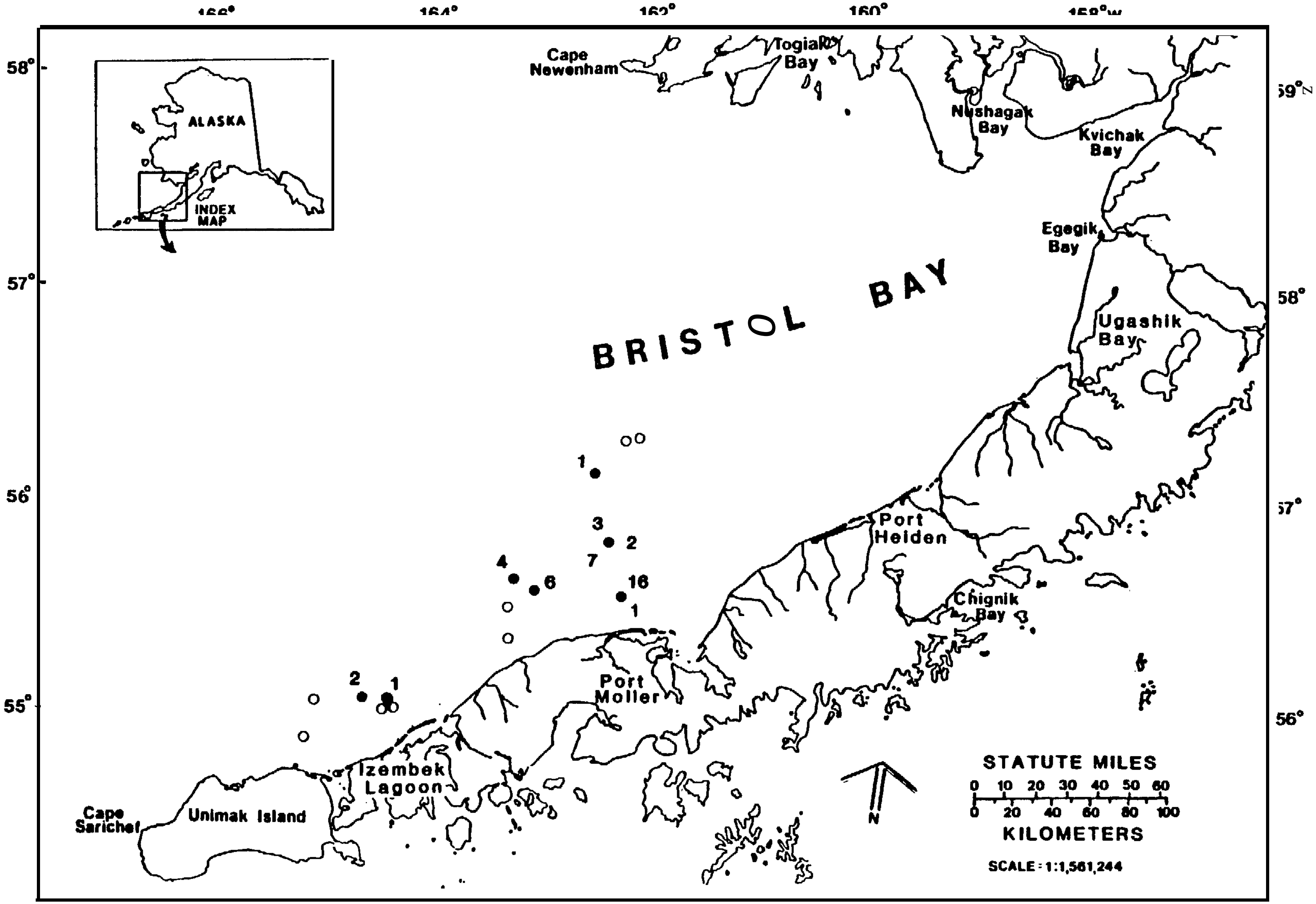


KEY:
○ None of this species taken

Juvenile Coho Salmon Purse Seine Catch August, 1968

Dames & Moore

Figure F-23

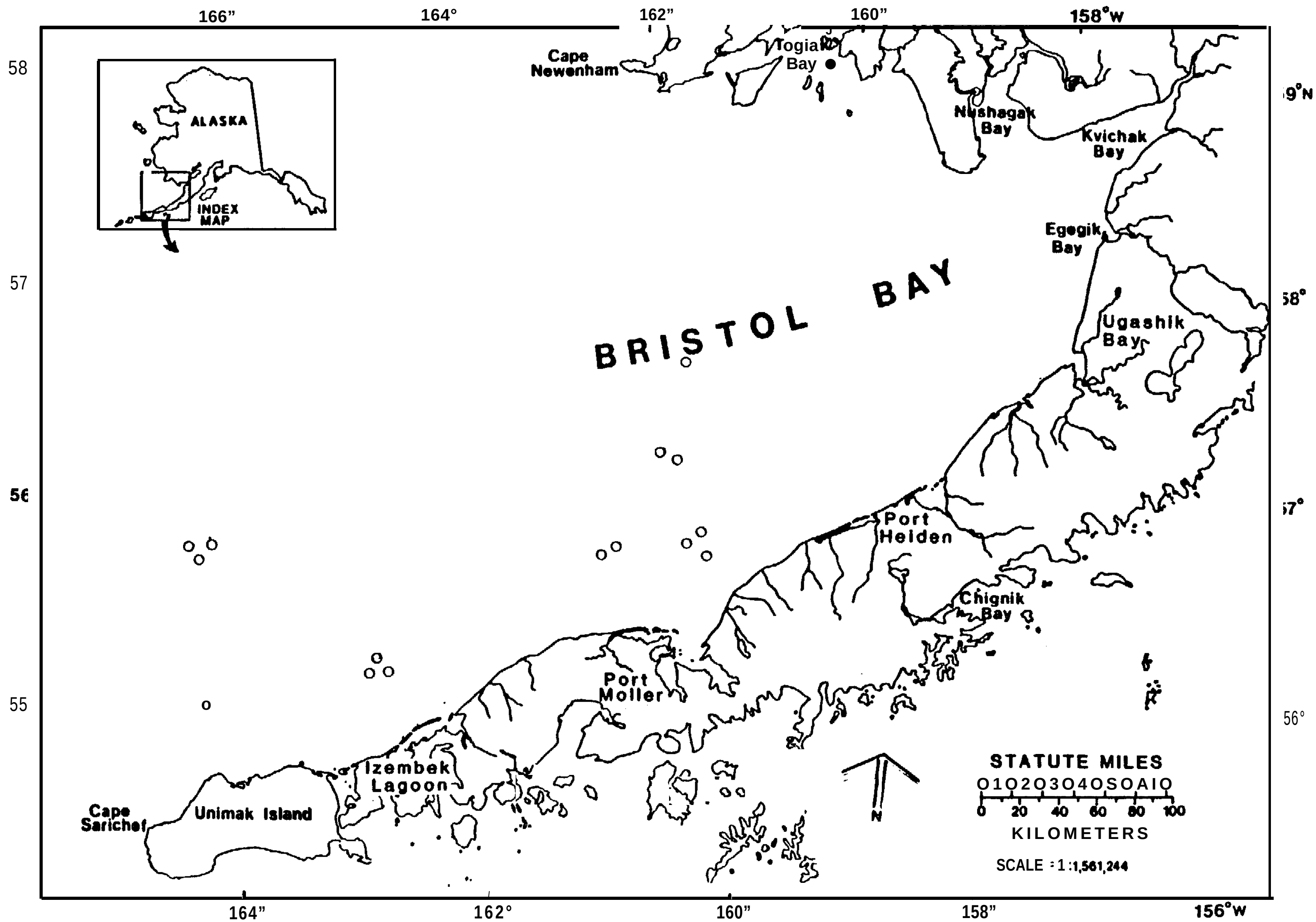


KEY:
○ None of his species taken

Juvenile Coho Salmon Purse Seine Catch September, 1968

Dames & Moore

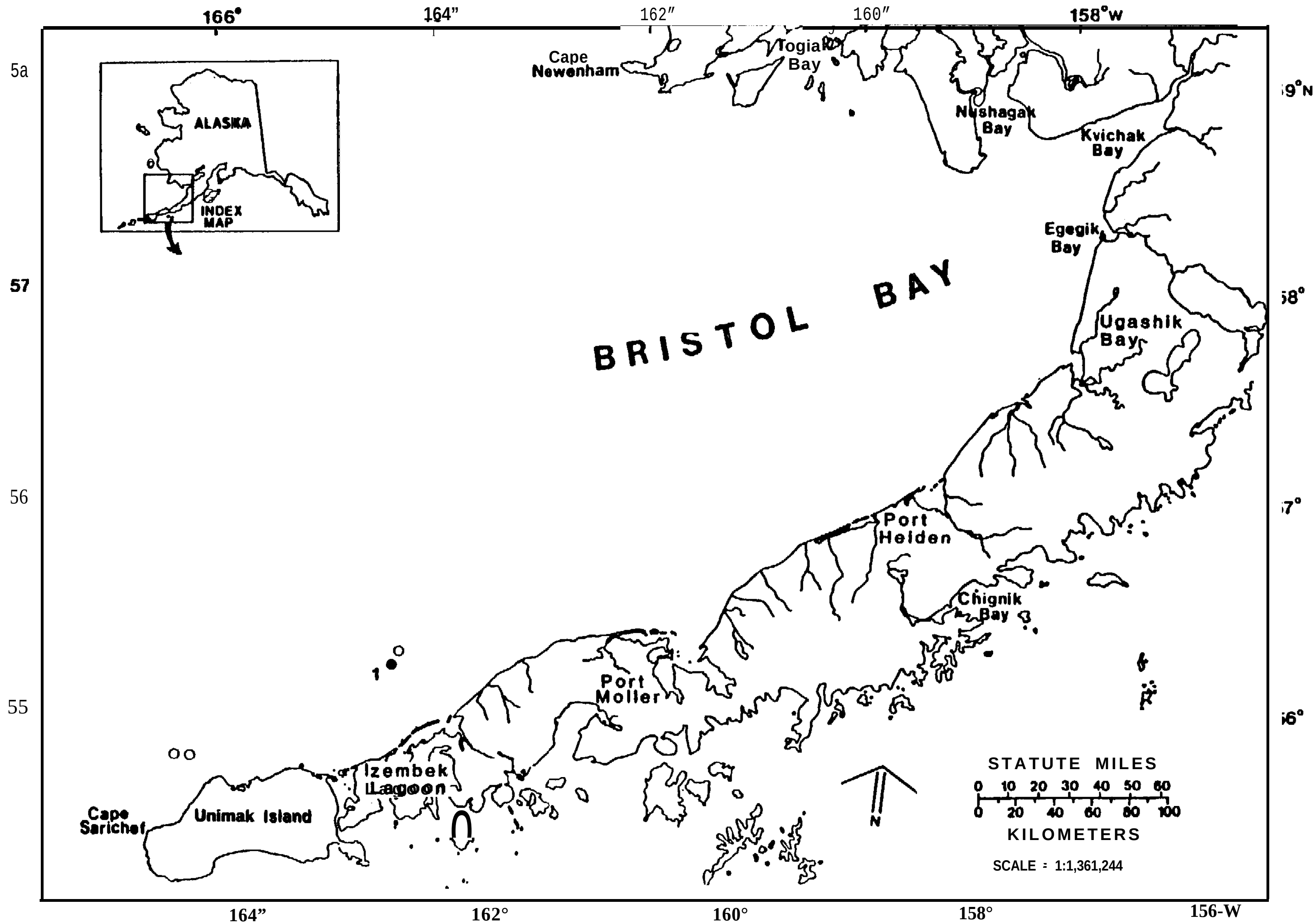
Figure F-24



Dames & Moore

KEY:
O None of this species taken

Juvenile Chinook Salmon Purse Seine Catch July, 1962



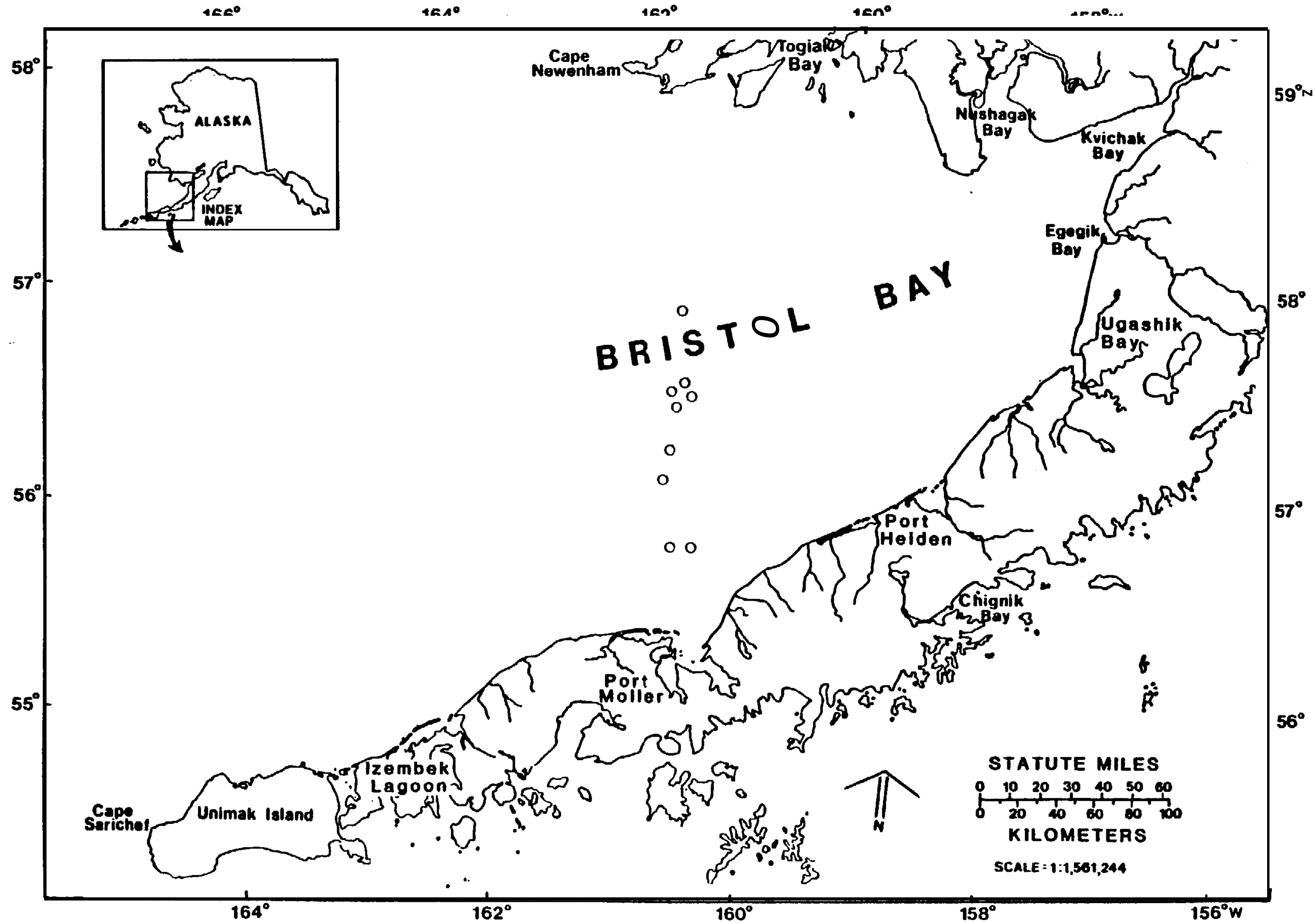
KEY:
o None of this species taken

Juvenile Chinook Salmon Purse Seine Catch August, 1962

339

Dames & Moore

Figure F-20

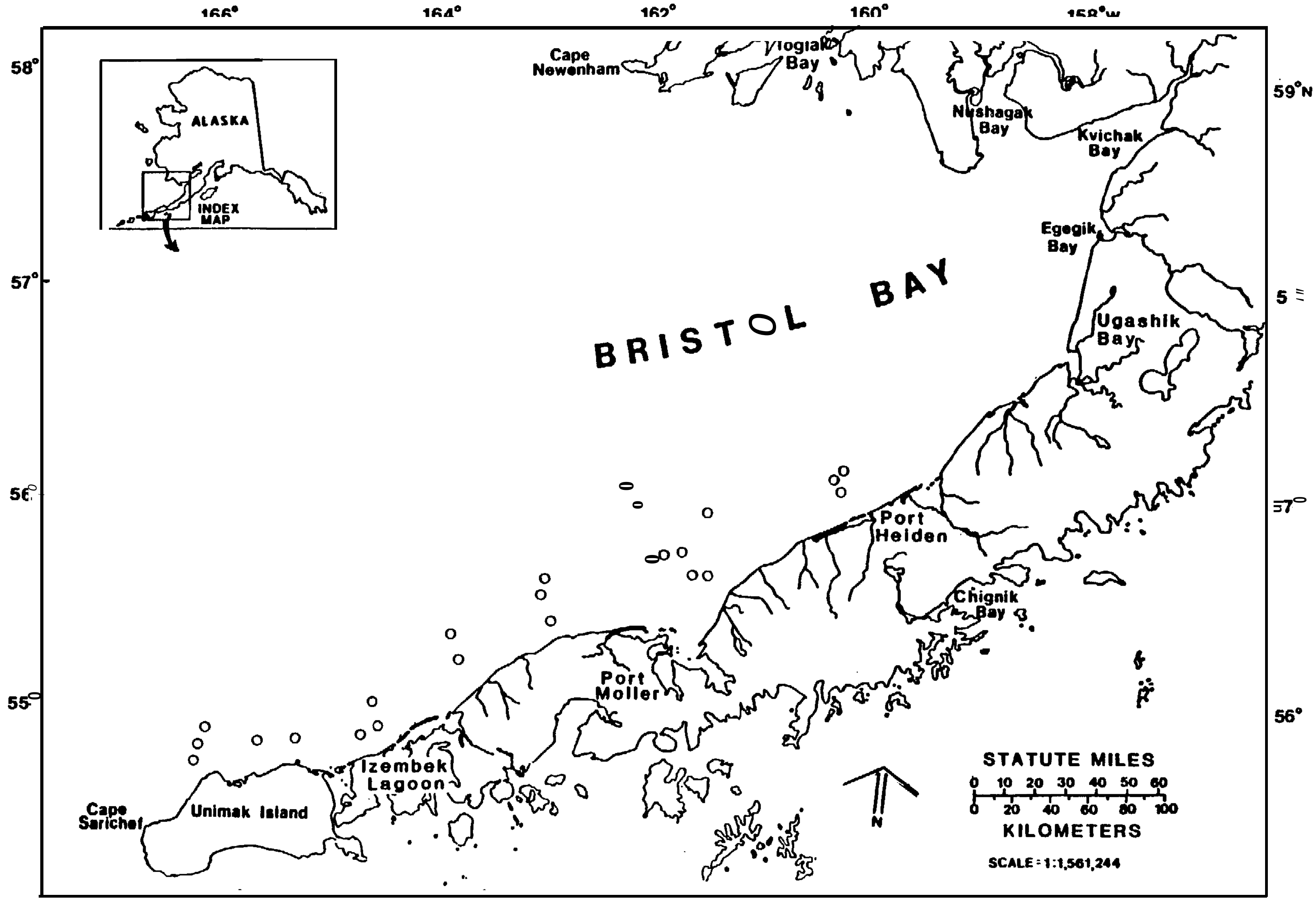


KEY:
○ None of this species taken

Juvenile Chinook
Salmon Purse Se ne Catch
June, 1966

Figure F-27

Dames & Moore

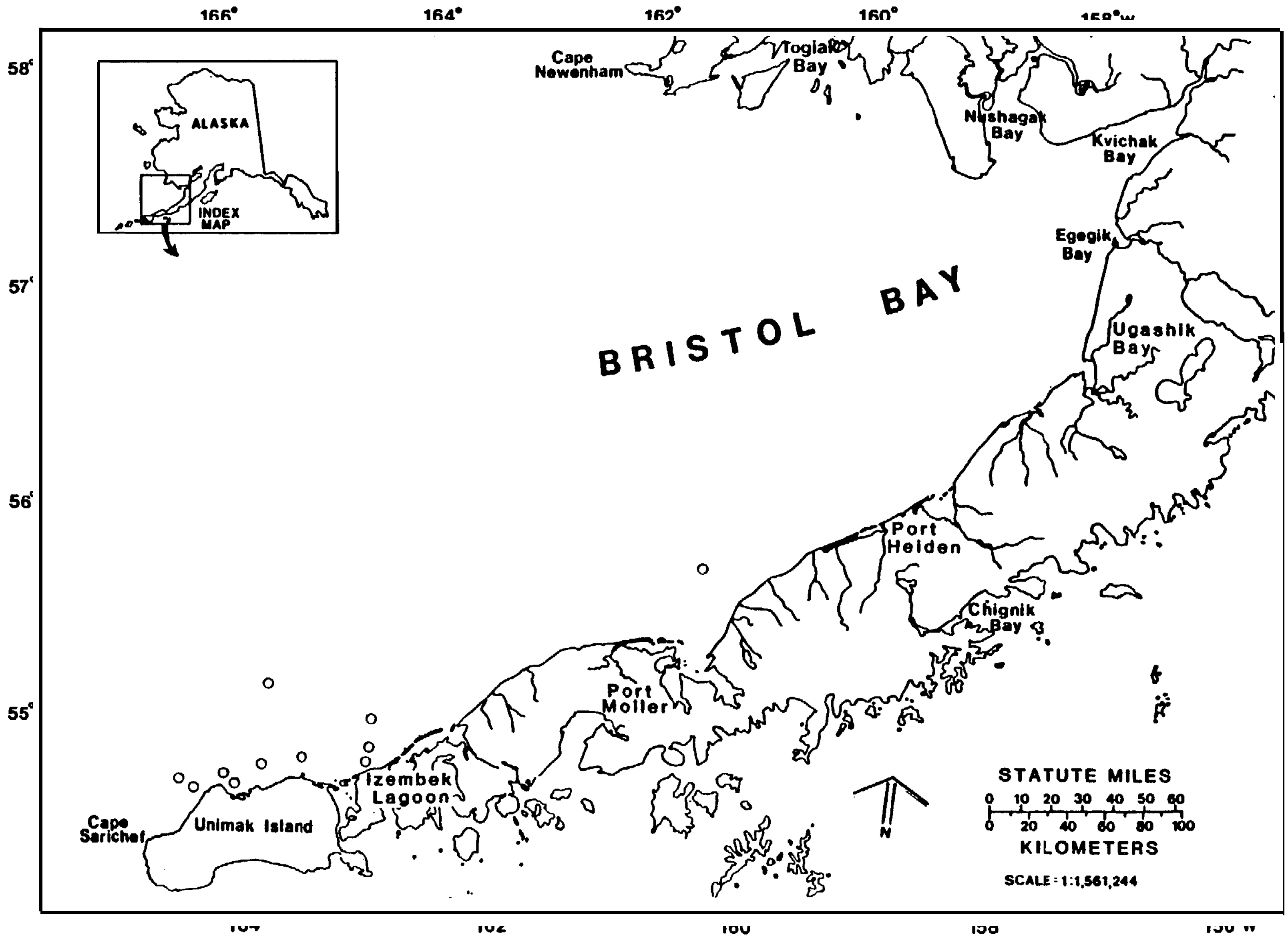


KEY:
○ None of this species taken

Juvenile Chinook Salmon Purse Seine Catch July, 1966

Figure F-28

Dames & Moore

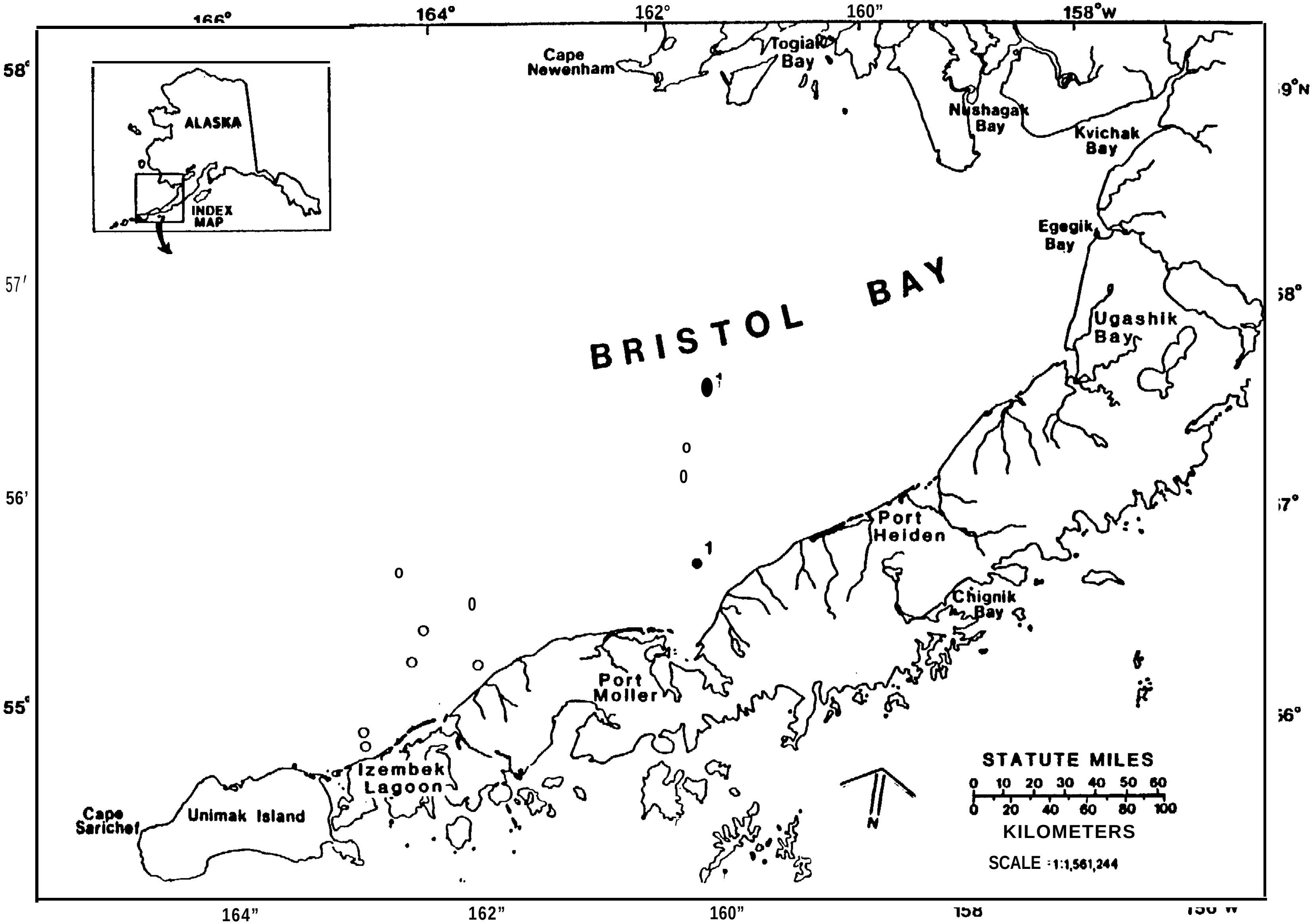


KEY:
○ None of this species taken

Juvenile Chinook Salmon Purse Se ne Ca ch August, 1966

Figure F-29

Dames & Moore

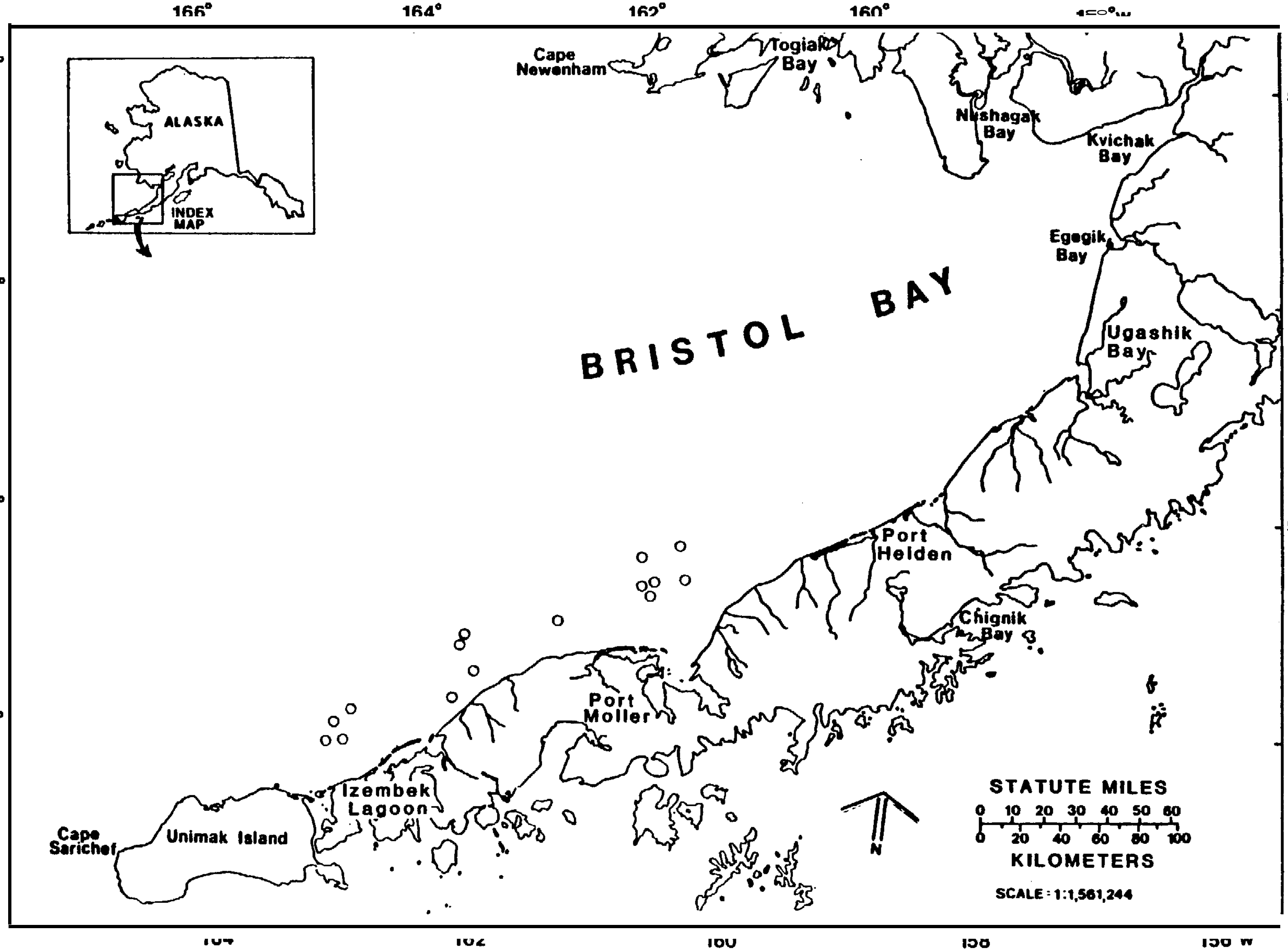


KEY:
O None of this species taken

Juvenile Chinook Salmon Purse Seine Catch September, 1967

Dames & Moore

343

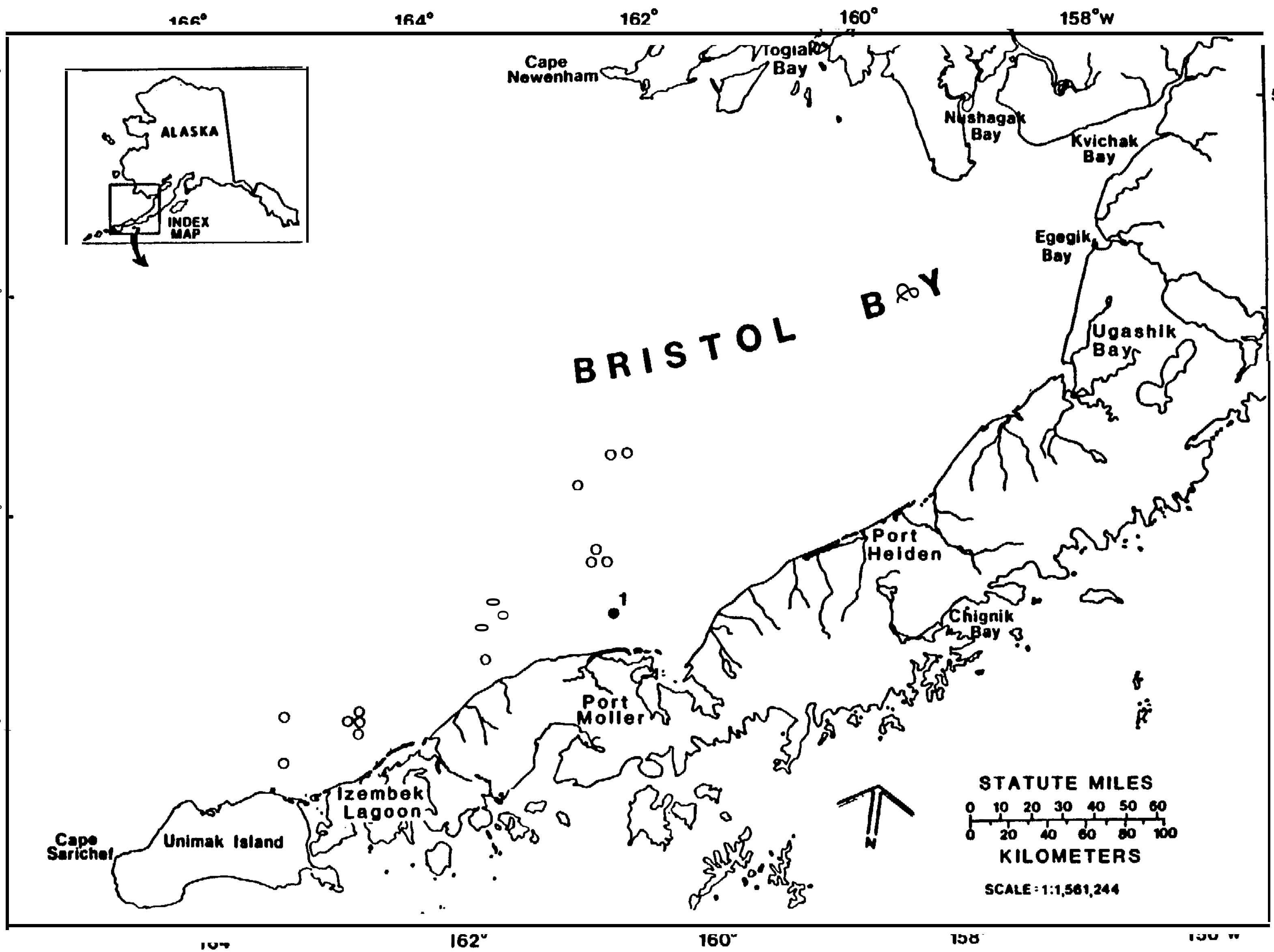


KEY:
○ None of this species taken

Juvenile Chinook
Salmon Purse Sei○e Catch
August, 1968

Figure F-31

Dames & Moore

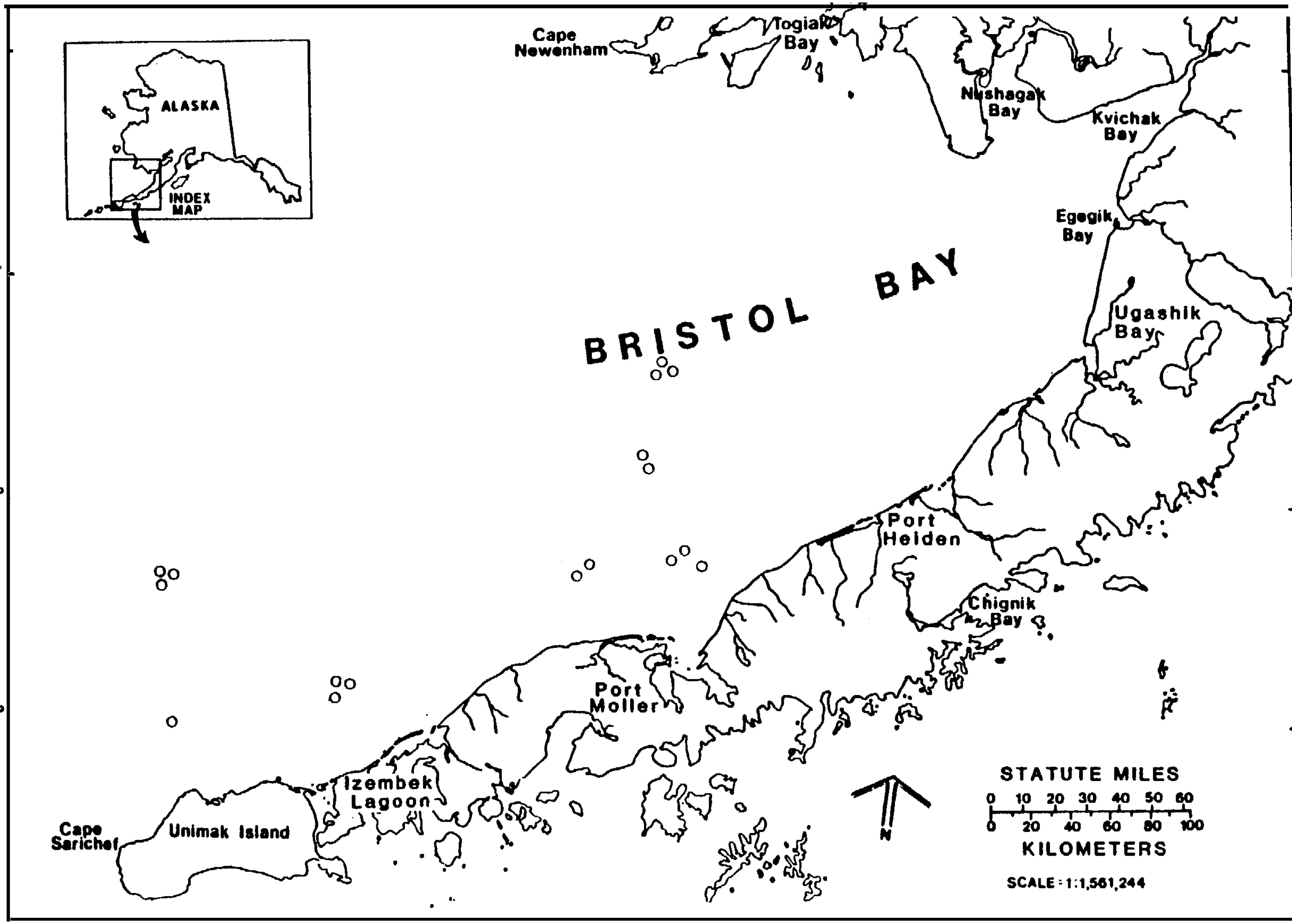


KEY:
○ None of his species taken

Juvenile Chinook Salmon Purse Seine Catch September, 1968

Dames & Moore

Figure F-32

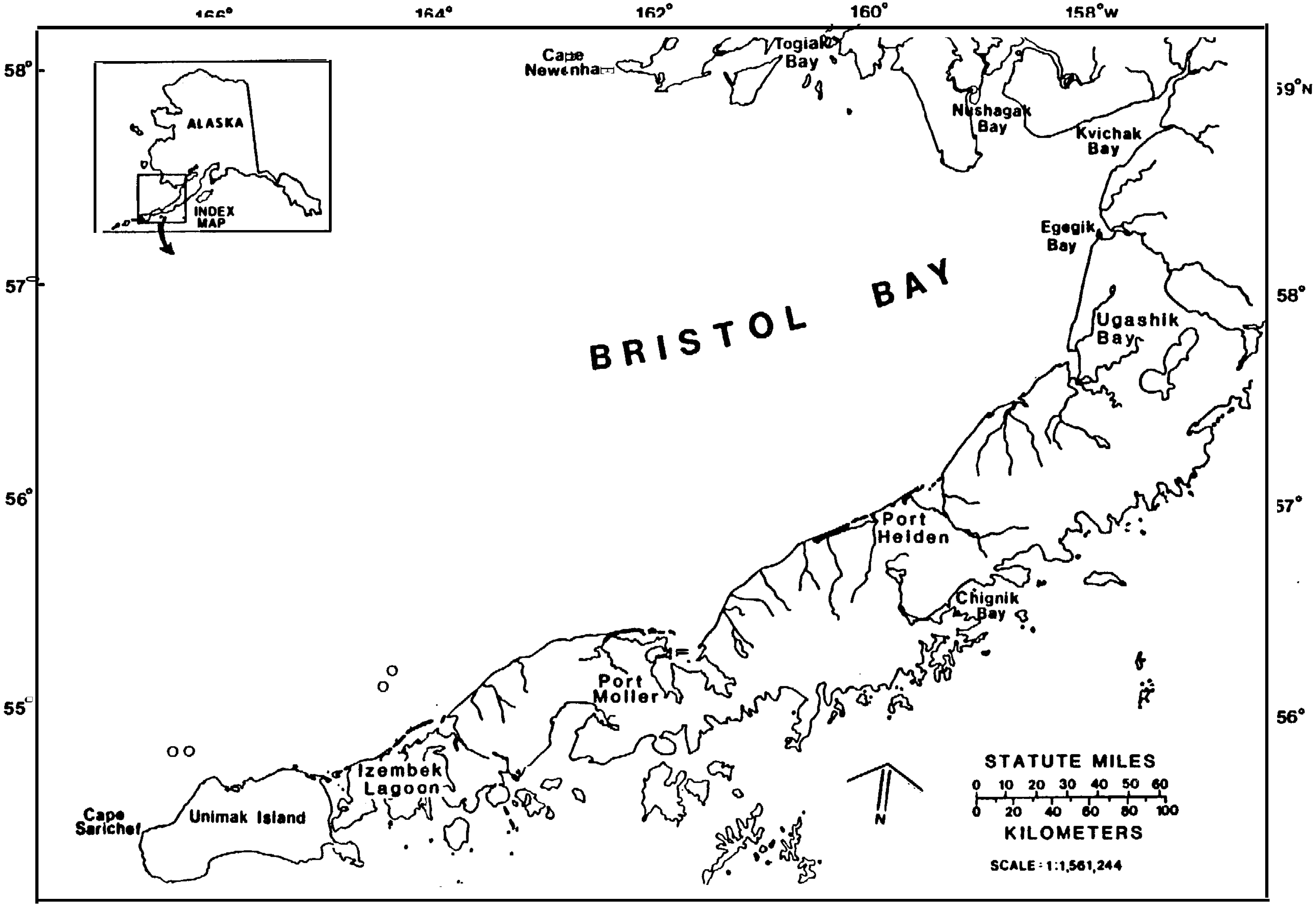


KEY:
○ None of this species taken

Juvenile Pink
Salmon Purse Seine C tch
July, 1962

Dames & Moore

Figure F-33

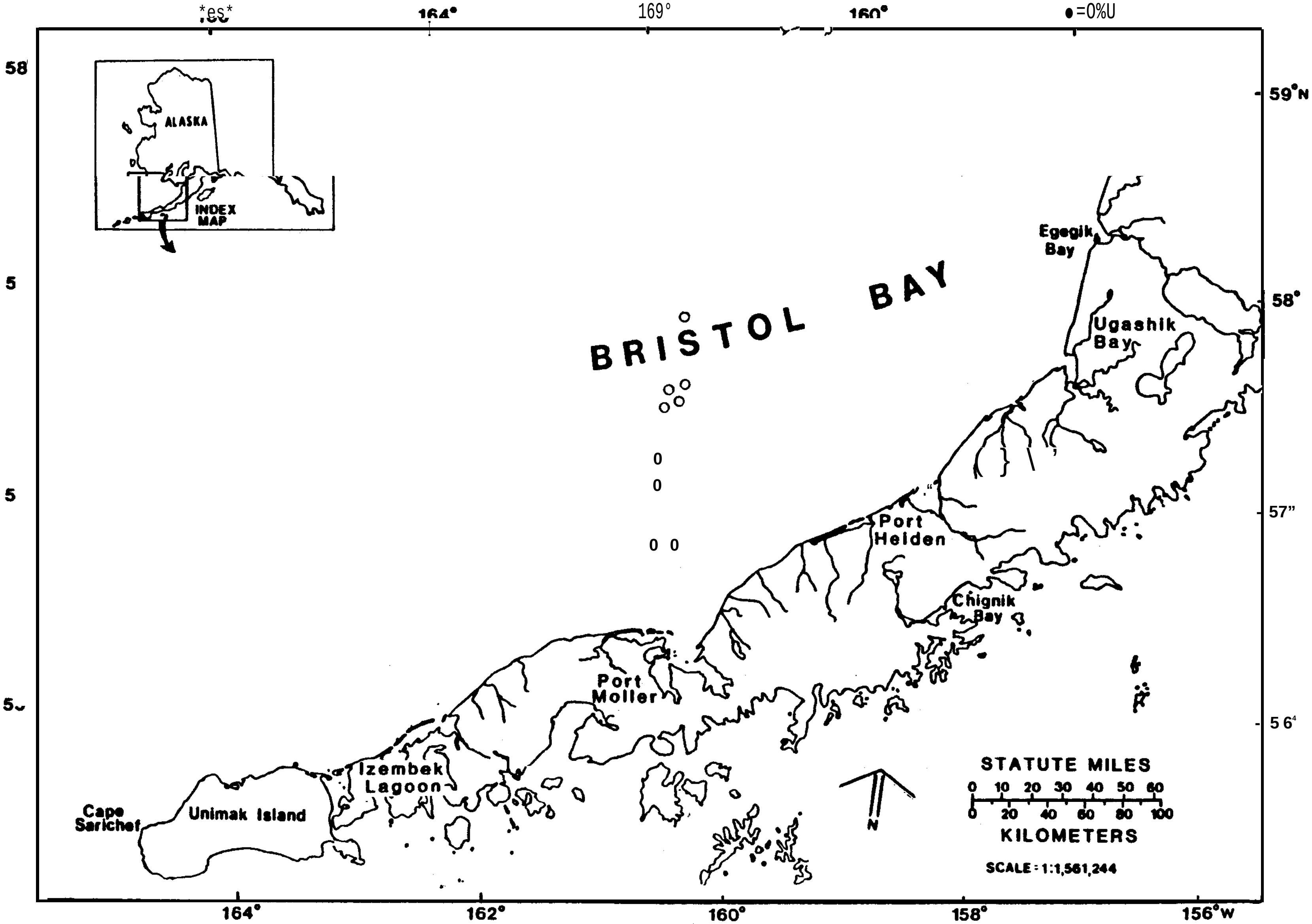


KEY:
○ None of this species taken

Juvenile Pink Salmon Purse Seine Catch August, 1962

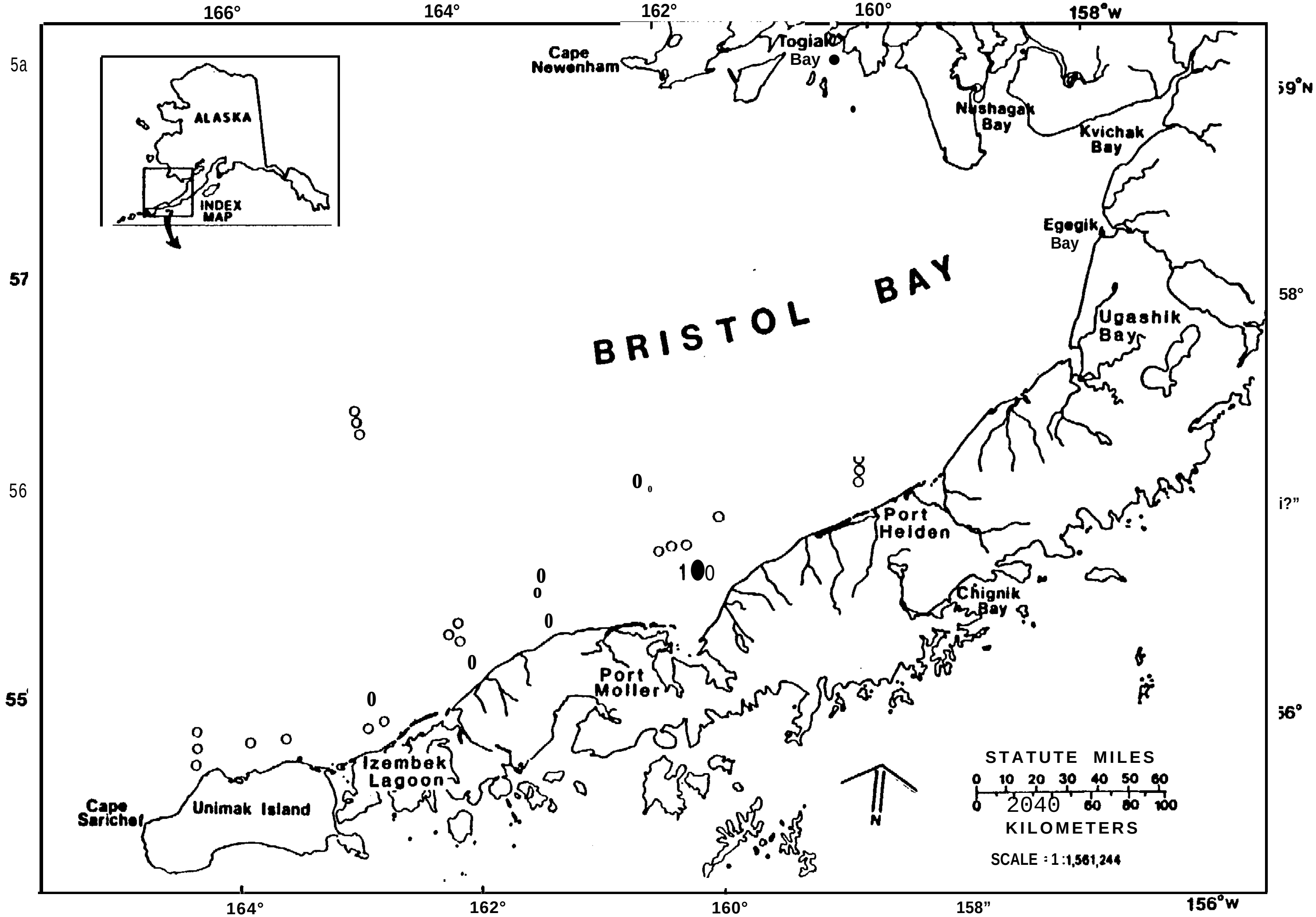
Figure F-34

Dames & Moore



KEY:
o None of this species taken

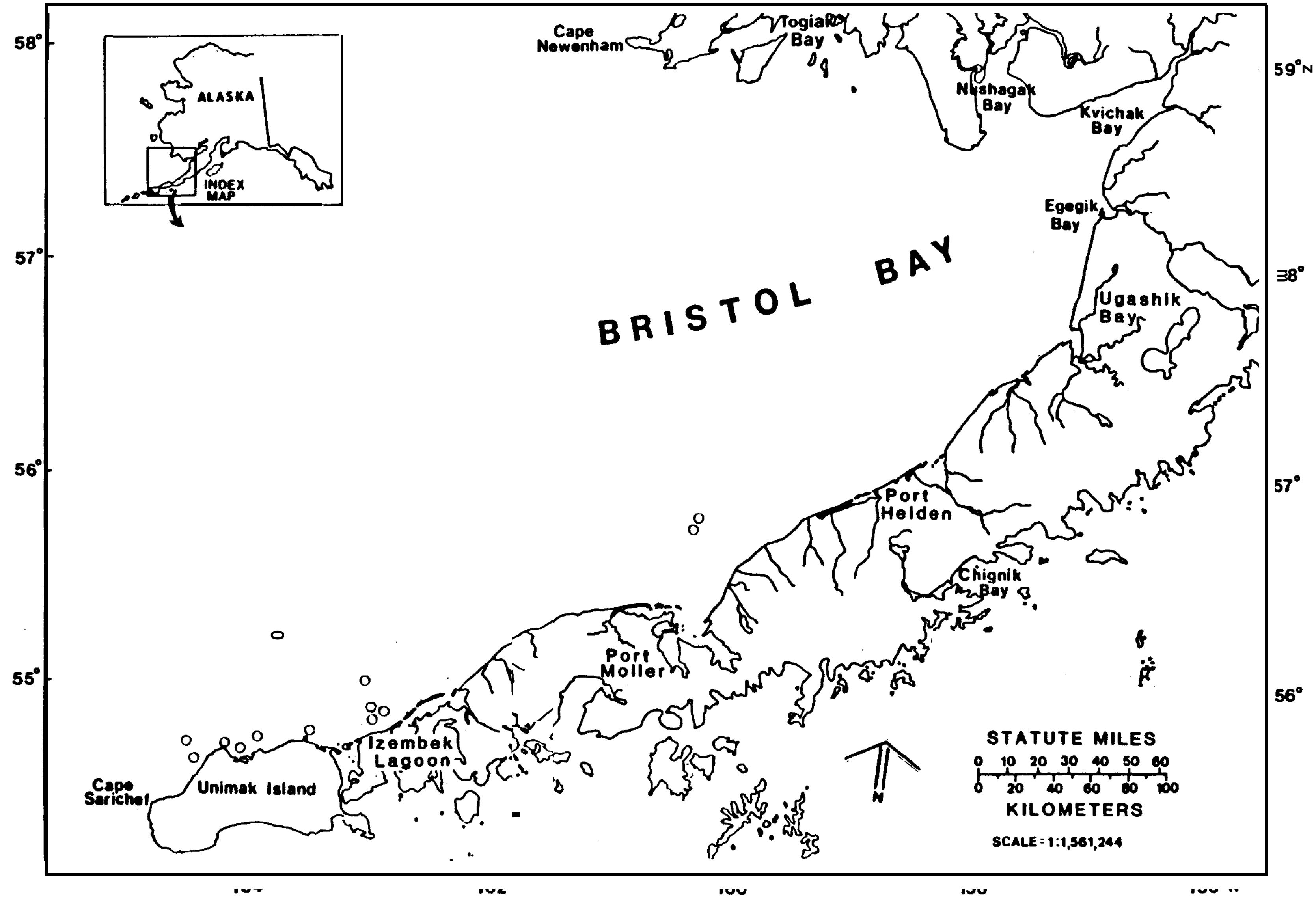
Juvenile Pink Salmon Purse Seine Catch June, 1966



Juvenile Pink Salmon Purse Seine Catch July, 1966

KEY:
O None of this species taken

Dames & Moore



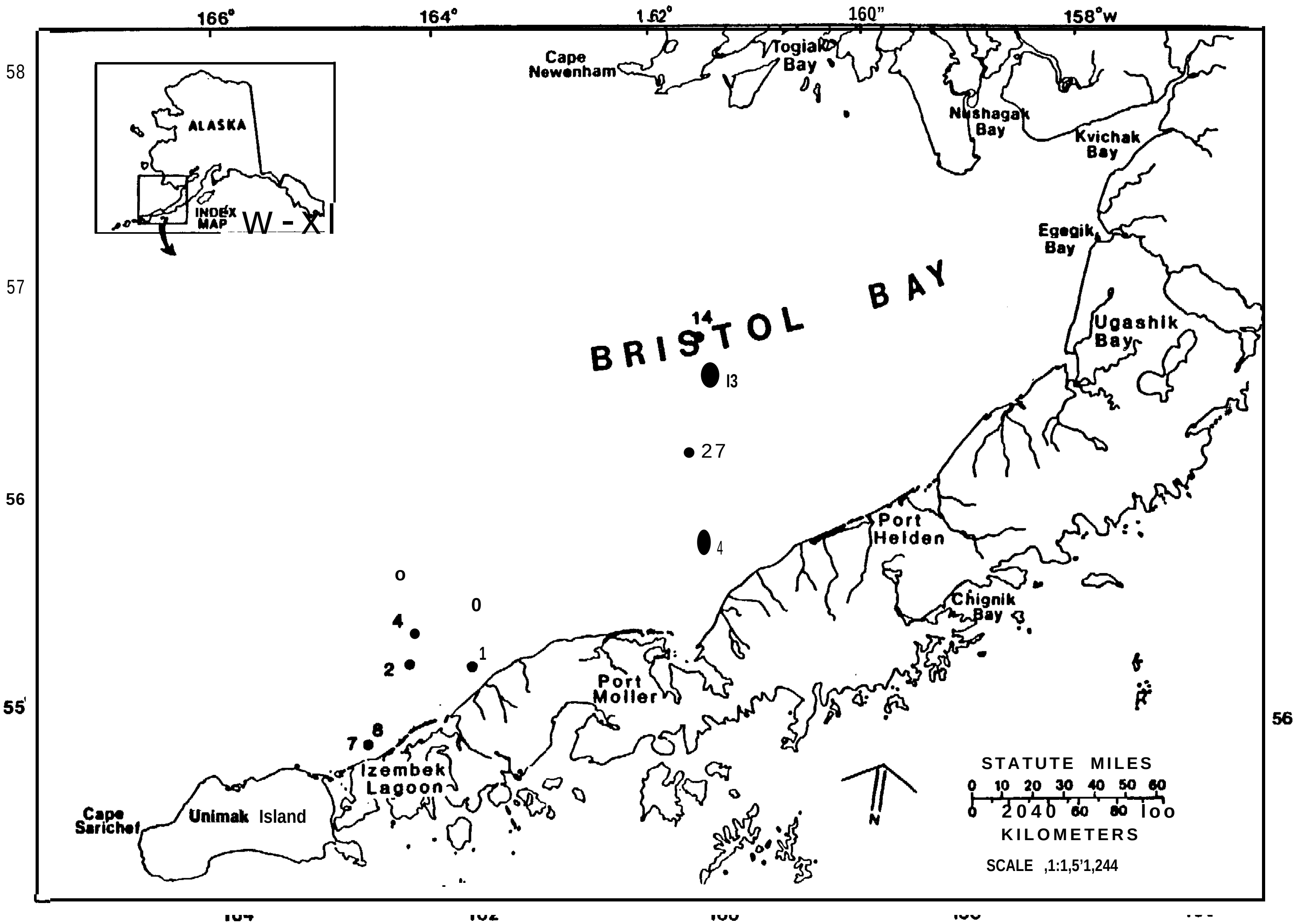
KEY:

○ None of this spec es taken

Juvenile Pink Salmon Purse Seine Catch August, 1966

Dames & Moore

Figure F-37

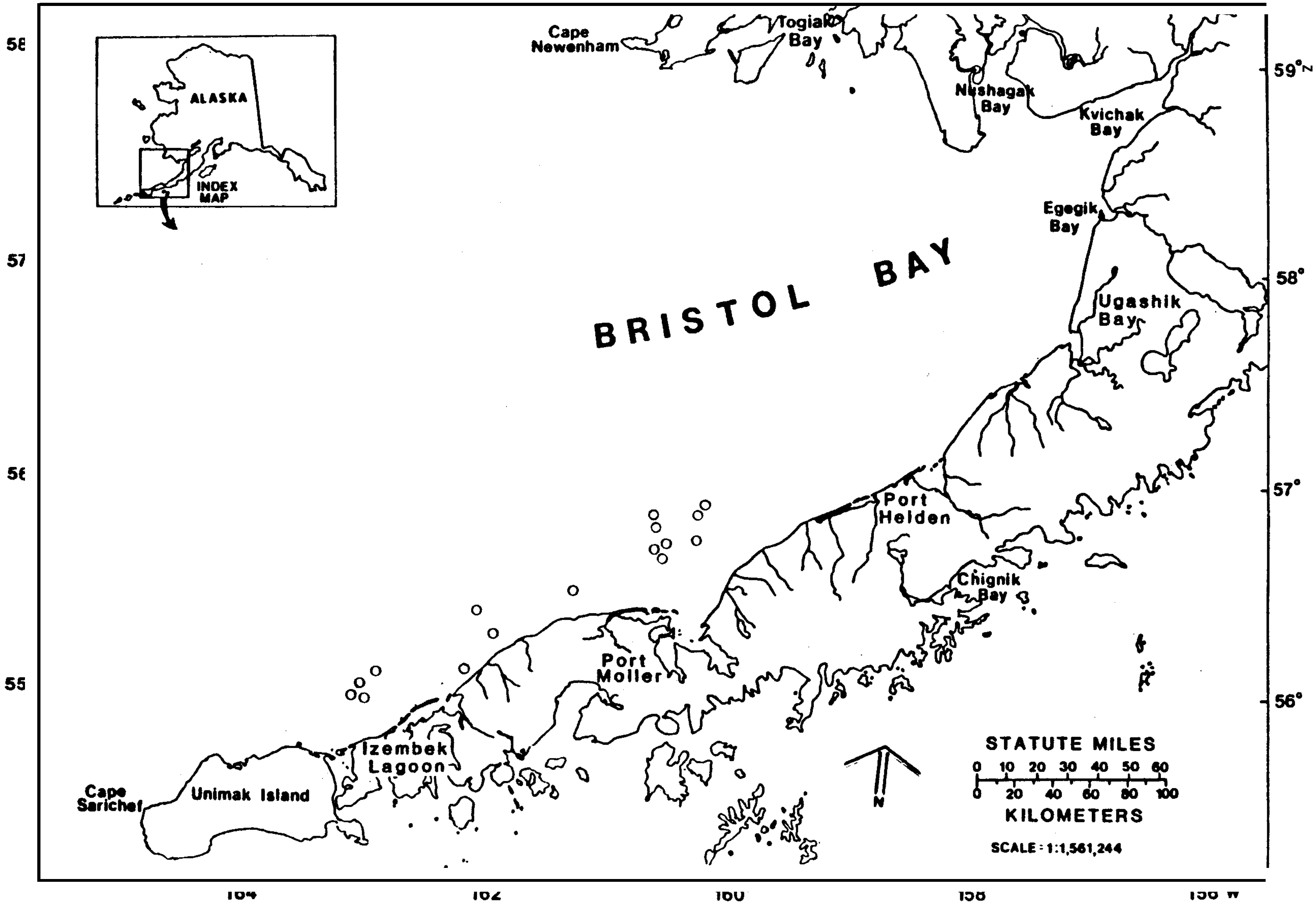


KEY:
O None of this species taken

Juvenile Pink Salmon Purse Seine Catch September, 1967

Dames & Moore

Figure F-30

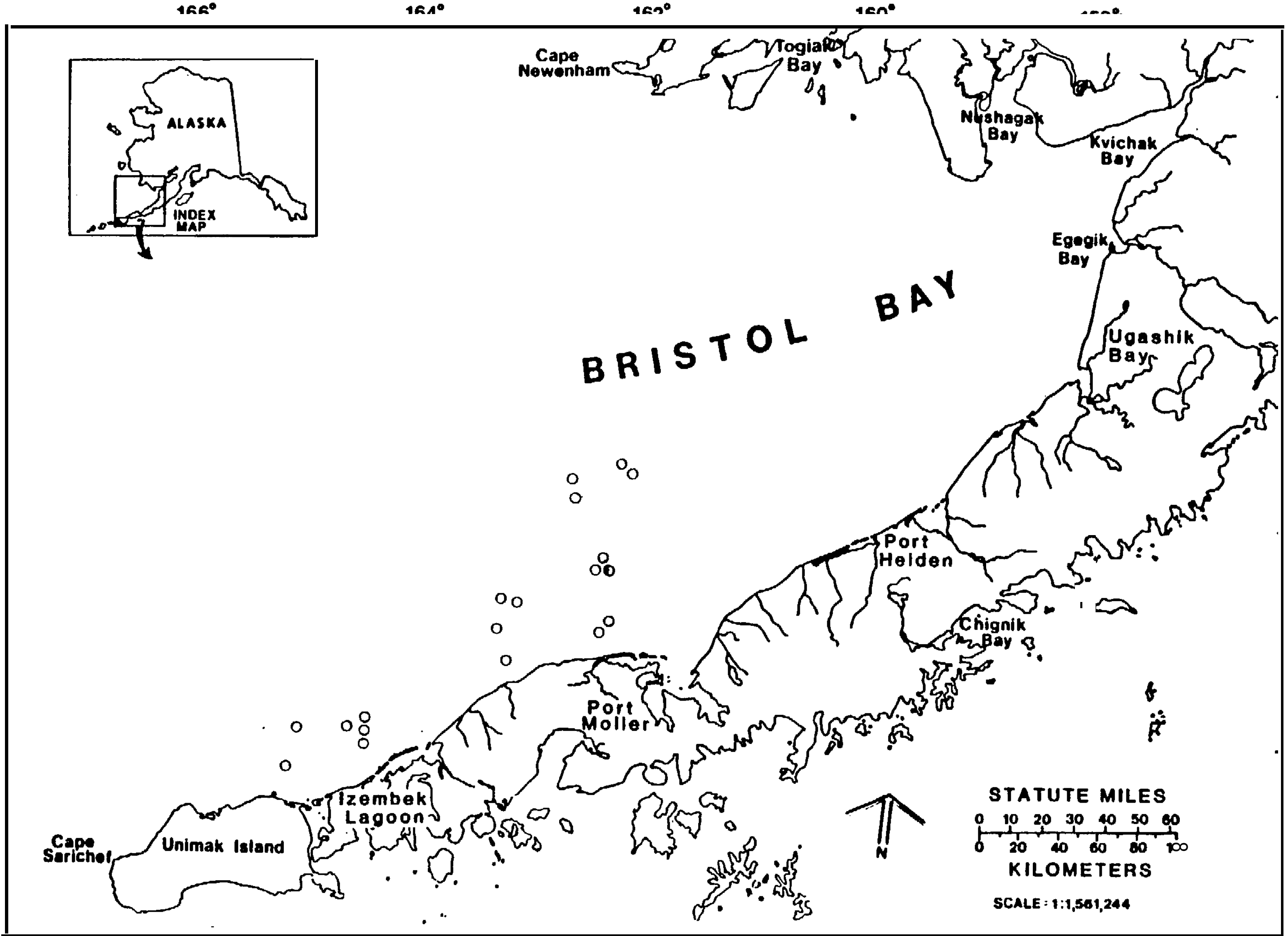


KEY:
○ None of this species taken

Juvenile Pink Salmon Purse Seine Catch August, 1968

Dames & Moore

Figure F-39



KEY:
○ None of this species taken

Juvenile Pink
Salmon Purse Seine Catch
September, 1968

Figure F-40

Dames & Moore

APPENDIX G

PURSE SEINE CATCH DATA 1985

APPENDIX TABLE G-1

PURSE SEINE CATCH DATA SUMMARY FOR CRUISE 4A

Transect 0	Station 0			Station 1			Station 2			Transect Summary		
Common Species Name	Freq	Mean Abund	Mean Weight	Freq	Mean Abund	Mean Height	Freq	Me Abund	Mea Weight	Freq	Mean Abund	Nean Weight
empty haul	0.0	0.0	0.0	0.O	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ARCTIC LAMPREY	0.0	0.0	0.0	0.0	0.0	0.O	0.0	0.0	0.0	0.0	0.0	0.0
PACIFIC HERRING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PINK SALNON Juv	0.O	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PINK SALNON Adult	0.0	0.O	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CHUM SALMON Juv	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CHUM SALMON Adult	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
COHO SALNON Juv	0.0	0.0	0.0	0.0	0.0	0.0	1.0	2.0	62.1	1.0	0,7	20.7
SOCKEYE SALMON Juv	1.0	30.0	181.9	3.0	755.2	6789.5	3.0	113.9	506.7	3.0	299.7	2519.4
SOCKEYE SALMON Adult	0.0	0.0	0.0	2.0	75.2	186923.4	1.0	2.0	5637. S	2.0	25.7	64187,0
CHINOOX SALMON Juv	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
DOLLY VARDEN Juv	0.0	0.0	0.0	1.0	12.0	1073.5	2.0	1.6	48.9	2.0	4.s	374,1
DOLLY VARDEN Adult	1.O	1.0	395.9	1.0	1.0	689.5	1.0	1.0	1262.2	3.0	1.0	782.5
SMELT UNID	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CAPELIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
RAINDON WELT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PACIFIC COD	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0 . 0
HALLEYE POLLOCK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
THREESPINE STICKLEBACK	0.0	0.0	0.0	1.0	1.0	3.8	0.0	0.0	0.0	1.0	0.3	1.3
GREENLING UNID	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0,0
WHITESPOTTED GREENLING	1.0	1.0	1.7	0.O	0.0	0.0	0.0	0.0	0.O	1.0	0.3	0.6
STAGHORN SCULPIN	0.0	0.0	0.0	0.O	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
GREAT SCULPIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
STURGEON POACHER	0.0	0.0	0.0	0.0	0.0	0.0	0,0	0.0	0.0	0.0	0.0	0.0
PACIFIC SANDFISH	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PACIFIC SAND LANCE	1.0	1.0	1.5	1.0	2.0	4.5	1.0	1.0	0.8	3.0	1.3	2.3
YELLOWFIN SOLE	0.0	0.0	0.0	0.0	0.0	0.0	1$0	1.0	216.7	1.0	0.3	72.2
STARRY FLOUNDER	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	55.6	1.0	0.3	18.5
Number of Species	4.0			6.0			8.0			10.O		
Mean Abundance		33.0			846.4			123,5			334.3	
Nean Weight (gas)			581.0			195484,2			7870.5			67978,6
Number of Sets			3.0			3.0			3.0			9.0

APPENDIX TABLE G-1

PURSE SEINE CATCH DATA SUMMARY FOR CRUISE 4A

Transect 2	Station 0			Station 1			Station 2			Station 3			Transect Summary		
Common Species Name	Freq	Mean Abund	Mean Height	Freq	Naan Abund	Nean Neight	Freq	Mean Abund	Mean Weight	Freq	Nean Abund	Nean Height	Freq	Wan Abund	Naan Weight
empty haul	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ARCTIC LAMPREY	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PACIFIC HERRING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PINK SALMON Juv	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PINK SALMON Adult	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	991.4	1.0	0.3	247.9
CHUM SALNON Juv	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CHUN SALNON Adult	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
COHO SALMON Juv	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	3s.1	0.0	0.0	0.0	1.0	0.3	8.8
SOCKEYE SALMON Juv	0.0	0.0	0.0	1.0	32.0	254.0	1.0	1165.0	25619.4	1.0	520.0	2081.1	3.0	429.3	6988.6
SOCKEYE SALNON Adult	0.0	0.0	0.0	1.0	1.0	722.4	2.0	2.4	4505.3	0.0	0.0	0.0	2.0	0.9	1306.9
CHINOOK SALNON Juv	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
DOLLY VARDEN Juv	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	39.7	0.0	0.O	0.0	100	0.3	9.9
DOLLY VARDEN Adult	0.0	0,0	0.0	0.0	0.0	0.0	0,0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SMELT UNID	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	5.0	38.6	1.0	1.3	9.7
CAPELIN	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	19.3	2.0	40.0	778.7	2.0	10.5	199.5
RAINKIN SMELT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	l.O	2.0	99.1	1.0	0.5	24.8
PACIFIC CUD	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HALLEYE POLLOCK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0,0	0.0	0.0
THREESPINE STICKLEBACK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
GREENLING UNID	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
WHITESPOTTED GREENLING	1.0	1.0	0.0	0.0	0.0	0,0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.3	0.2
STAGHORN SCULPIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
GREAT SCULPIN	0.0	0.O	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
STURGEON POACHER	0.0	0.0	0.0	0.O	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PACIFIC SANDFISH	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	26.3	1.0	0.3	6.6
PACIFIC SAND LAKE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	11.0	31.6	1.0	2.8	7.9
YELLOWFIN SOLE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
STARRY FLOUNDER	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Number of Species	1.0			2.0			5.0			7.0			11,0		
Mean Abundance		1.0			33.0			1170.4			580.0			446.3	
Mean Weight (gas)			0.8			976.4			30218.8			4046. B			8810.7
Number of Sets			1.0			1.0			2.0			2.0			6.0

APPENDIX TABLE G-1

PURSE SEINE CATCH DATA SUNNARY FOR CRUISE 4A

Transect 4	Station O			Station 1			Station 2			Station 3			Transect Summary		
Common Species Naae	Freq	Naan Abund	Nean Weight	Freq	Nean Abund	Haan Weight	Freq	Mean Abund	Nean Weight	Freq	Nean Abund	Nean Weight	Freq	Mean Abund	Nean Weight
empty haul	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0
ARCTIC LAMPREY	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PACIFIC HERRIM	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0,0	0.0
PINK SAMON Juv	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PINK SALMON Adult	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CHUM SALMON JuV	0.0	0.0	0.0	0.0	0,0	0.0	0.0	0.0	0.0	0,0	0.0	0.0	0.0	0.0	0.0
CHUM SALMON Adult	0,0	0.0	0.0	1.0	1.0	2104.6	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.3	546.2
COHO SALMON Juv	0.0	0.0	‘0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.0	13.6	48S ,8	1.0	3.4	121.5
SOCKEYE SALMON Juv	1.0	138.0	1242.4	3.0	50.8	619.0	2.0	86.7	613.5	3.0	29.0	381.1	4.0	76.1	714.0
SOCKEYE SALNON Adult	2.0	4.1	86390.3	0.0	0.0	0.0	1.0	25.0	59511.9	1.0	1.0	1873.4	3.0	7.5	36%3.9
CHINOOK SALMON Juv	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	108.7	1.0	0.3	27.2
DOLLY VARDEN Juv	0.0	0.0	0.0	1.0	1.0	17.5	1.0	5.0	454.6	2.0	4.8	267.2	3.0	2.7	184.8
DOLLY VARDEN Adult	1.0	1.0	5%.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.3	149.2
SMELT UNID	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CAPELIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
RAINBOW WELT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PACIFIC COD	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HALLEYE POLLOCK	0.0	0.0	0.0	0.0	0.0	0.0	0,0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
THREESPINE STICKLEBACK	1.0	1.0	0.9	1.0	2.0	4.4	0.0	0.0	0.0	0.0	0.0	0.0	2.0	0.8	1.3
GREENLING UNID	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
WHITESPOTTED GREENLING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
STAGHORN SCULPIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
GREAT SCULPIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
STURGEON POACHER	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PACIFIC SANDFISH	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	83.4	0.0	0,0	0$0	1.0	0.3	20.9
PACIFIC SAND LANCE	1.0	2.0	7.9	2.0	1.5	8.5	2.0	61.4	366.4	4,0	106.8	443.2	4,0	42.9	206.5
YELLOWFIN SOLE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
STARRY FLOUNDER	0.0	0 . 0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Number of Species	5.0			5.0			5.0			6.0			10.0		
Nean Abundance		146.1			56.3			179.1			156.2			134.4	
Nean Weight(gms)			88238.1			2834.0			61029.8			3559.4			38915.3
Number of Sets			3.0			4.0			4.0			5.0			16.0

APPENDIX TABLE G-1

PURSE SEINE CATCH DATA SUNNARY FOR CRUISE 4A

Transect 6	Station O			Station 1			Station 2			Station 3			Transect Summary		
Common Species Name	Freq	Mea Abund	Near Weight	Freq	Mean Abund	Mean Weight	Freq	Mean bu	Nean Weight	Freq	Mean Abund	Nean Weight	Freq	Nean Abund	Nean Height
empty haul	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	o.o	0.0	0.0	0.0
ARCTIC LAMPREY	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PACIFIC HERRING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PINK SALNON Juv	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0,0	0.0	0.0
PINK SALMON Adult	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CHUM SALNON Juv	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CHUN SALMON Adult	0.0	0.0	0.0	0.0	0.O	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
COHO SALNON Juv	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SOCKEYE SALMON Juv	0.0	0.0	0.0	0.0	0.0	0.0	1.0	6.0	60S. S	1.0	3.0	91.7	2.0	2.3	175.1
SOCKEYE SALMON Adult	0.0	0.0	0.0	0.0	0.0	0.0	100	10.0	26847.0	0.0	0.0	0.0	1.0	2.5	6711.8
CHINOOK SALMON Juv	0.0	0.O	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
DOLLY VARDEN Juv	0,0	0.0	0.0	0,0	0.0	0.0	1.0	1.0	5.0	0.0	0.0	0.0	1.O	0.3	1.3
DOLLY VARDEN Adult	1.0	2.0	1417.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.O	0.0	1.0	0.5	3s4.3
WELT UNID	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0,0	0.0	0.0	0.0	0.0	0.0
CAPELIN	0.0	0.0	0.0	0.0	0.0	0.O	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
RAINBOW WELT	0.0	0.0	0.0	0.0	0.0	0.O	0.0	0.0	0.0	0.O	0.0	0.0	0.0	0.0	0.O
PACIFIC COD	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HALLEYE POLLOCK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
THREESPINE STICKLEBACK	1.0	2.0	3.3	0.0	0.0	0.0	1.0	1.0	0.8	0.0	0,0	0.0	2.0	0.8	1.0
GREENLING UNID	0.0	0.0	0.0	0.0	0.0	0.0	0.O	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
WHITESPOTTED GREENLING	1.0	1.0	1.0	1.0	1.0	1.0	0.0	0.0	0.0	1.0	6.0	4.2	3.0	2.0	1.6
STAGHORN SCULPIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0*0	0.0	0.0	0.0	0.0	0.0
GREAT SCULPIN	000	0.0	0.0	0.0	0.0	0.0	0,0	0.0	0.0	0.0	0.0	0.O	0.0	0.0	0.0
STURGEON POACHER	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.O	0.0	0.0	0.0	0.0
PACIFIC SANDFISH	0.0	0.0	0.0	1.0	1.0	119,1	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.3	29.8
PACIFIC SAND LANCE	0.0	0.0	0.0	0.0	0.0	0.0	2.0	8.8	51.7	2.0	12.4	70.1	2.0	5.3	30. s
YELLWIN SOLE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
STARRY FLOUNDER	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Number of Species	3.0			2.0			5.0			3.0			8.0		
Mean Abundance		5.0			2.0			26.0			21.4			13.8	
Mean Height (gas)			1421.3			120.1			27513.0			166.0			7305.1
Number of Sets			2.0			2,0			2.0			2.0			8.0

APPENDIX TABLE G-2

PURSE SEINE CATCH DATA SUMMARY FOR CRUISE 4B

Transect 0	Station 0			Station 1			Station 2			Transect Summary		
Common Species Name	Freq	Mean Abund	Naan Height	Freq	Mean Abund	Mean Weight	Freq	Nean Abund	Nean Height	Freq	Mean Abund	Nean Height
eapty haul	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ARCTIC LAMPREY	0.0	0.0	0.0	0.0	0.0	0.0	6.0	1.0	4.6	1.0	0.3	1.5
PACIFIC HERRING	0.0	0.0	0.0	0.0	0.0	0.0	1.0	11.0	1746.4	1.0	3.7	582.1
PINK SALNON Juv	0.0	0.0	0.0	0.0	0.0	0.0	2.0	1.8	3.5	1.0	0.6	1.2
PINK SALNON Adult	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	855.4	1.0	0.3	285.1
CHUM SALNON Juv	0.0	0.0	0.0	1.0	2.0	4.2	9.0	10.7	25.4	2.0	4.2	9.9
CHUM SALMON Adult	0.0	0.0	0.0	1.0	1.0	3027.3	1.0	1.0	2790.0	2.0	0.7	1939.1
COHO SALMON Juv	0.0	0.0	0.0	1.0	2.0	193.0	9.0	6.8	649.6	2.0	2.9	280.9
SOCKEYE SALMON Juv	5.0	99.2	17s1.7	5.0	41.1	420.2	10.0	72.2	492.4	3.0	70.8	8s8.1
SOCKEYE SALMON Adult	0.0	0.0	0.0	2.0	8.5	20487.5	‘4.0	19.5	45169.3	2.0	9.3	21885.6
CHINOOK SALNON Juv	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	4.2	1.0	0.3	1.4
DOLLY VARDEN Juv	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
DOLLY VARDEN Adult	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SMELT UNID	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CAPELIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
RAINBOW SMELT	0,0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PACIFIC COD	0.0	0.0	0.0	0,0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
WALLEYE POLLOCK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.O	0.0	0.0	0.0
THREESPINE STICKLESACK	0.0	0.0	0.0	1.0	4.0	2.6	2*0	0.8	2.1	2.0	1.6	1.6
GREENLING UNID	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.O	0.0
WHITESPOTTED GREENLING	1.0	3.0	5.0	0.0	0.0	0.0	3.0	4.7	5.2	2.0	2.6	3.4
STAGHORN SCULPIN	0.0	0*0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
GREAT SCULPIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
STURGEON POACHER	0.0	0,0	0.0	0.0	0.0	0.0	0.0	0.0	0.O	0.0	0.0	0.0
PACIFIC SANDFISH	1.0	1.0	35.1	0.0	0.0	0.0	1.0	1.0	71.4	2.0	0.7	3s.5
PACIFIC SAND LANCE	0.0	0.0	0.0	1.0	4.0	4.4	2.0	4.8	4.8	2.0	2.9	3.1
YELLOWFIN SOLE	0.0	0.0	0.0	1.0	1.0	2708.9	2.0	0.9	204.0	2.0	0.6	971.0
STARRY FLOUNDER	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Number of Species	3.0			8.0			1s.0			15.0		
Mean Abundance		103.2			63.6			138.2			101.7	
Haan Height (gas)			1791.8			26s48.1			52028.3			26S89.4
Number of Sets			5.0			5.0			10.0			20.0

APPENDIX TABLE G-2

PURSE SEINE CATCH DATA SUMMARY FOR CRUISE 4B

Transect 2	Station O			Station 1			Station 2			Station 3			Transect Summary		
Common Species Name	Freq	Nean Abund	Naan Weight	Freq	Nean bund	Nean Height	Freq	Nean Abund	Nean Weight	Freq	Nean bu	Naan Weight	Freq	Nean Abund	Mea Weight
empty haul	2.0	0.0	0.0	0.0	0.0	0.0	0*0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0
ARCTIC LAMPREY	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PACIFIC HERRING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	11.0	2412.8	1.0	2.8	603.2
PINK SALMON Juv	0.0	000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0,0	0.0	0.0
PINK SALMON Adult	0.0	0.0	000	0.0	0.0	0.0	0.0	0,0	0.0	1.0	1.0	1193.2	1.0	0.3	298.3
CHUM SALNON Juv	0.0	0.0	0.0	0.0	0.0	0.0	4.0	23.0	72.9	0.0	0.0	0.0	1.0	5.8	18.2
CHUM SALMON Adult	0*0	0,0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0 . 0
COHO SALMON Juv	0.0	0.0	0.0	0.0	0.0	0.0	3.0	2.s	100.6	7.0	21.4	189.0	2.0	6.0	72.4
SOCKEYE SALNON Juv	0.0	0.0	0.0	4.0	21.9	257.3	5.0	43.5	349.3	5.0	64.5	540.5	3.0	32.5	286.8
SOCKEYE SALMON Adult	0.0	0.0	0.0	1.0	3.0	5667.8	1.0	2.0	4646.8	3.0	6.1	12489.8	3.0	2.0	5701.1
CHINOOK SALMON Juv	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
DOLLY VARDEN Juv	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
DOLLY VARDEN Adult	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
WELT UNID	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CAPELIN	0.0	0.0	0.0	0.0	0.0	0.0	000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
RAINBOW SMELT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0	4.8	186.4	1.0	1.2	46.6
PACIFIC COD	0.0	0.0	0.0	1.0	1.0	0.8	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.3	0.2
HALLEYE POLLOCK	0.0	0.0	0.0	0.0	0 . 0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
THREESPINE STICKLEBACK	2,0	3,2	1.8	1.0	1.0	0.8	0.0	0.0	0.0	0.0	0.0	0.0	2.0	1.1	0.7
GREENLING UNID	1.0	1.0	0.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.3	0.2
WHITESPOTTED GREENLING	2.0	3.9	5.1	2.0	2.1	3.0	2.0	0.9	1.3	2.0	9.7	18.9	4s0	4.2	7.1
STAGHORN SCULPIN	0.0	0.0	0.0	-0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
GREAT SCULPIN	0*0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1*0	1.0	2.6	1.0	0.3	0.7
STURGEON POACHER	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1.7	1.0	0.3	0.4
PACIFIC SANDFISH	0.0	040	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	20.0	1974.1	1.0	5.0	493.5
PACIFIC SAND LANCE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0	3.8	26,3	1.0	1.0	6.6
YELLOWFIN SOLE	0.0	0.0	0.0	0.0	0.0	0.0	1.0	2.0	520.9	0.0	0.0	0.0	1.0	0.5	130.2
STARRY FLOUNDER	0.0	0.0	0.0	0.0	0.0	0.0	1.0	3.0	354.2	2.0	0.9	438.1	2.0	1.0	198.1
Number of Species	3.0			5.0			7.0			12.0			17,0		
Nean Abundance		8.1			29.0			76.9			145.2			64.8	
Nean Weight (gms)			7.0			5929.7			6046.0			19473.4			7864,2
Number of Sets			5.0			5.0			5.0			5.0			20,0

APPENDIX TABLE G-2

PURSE SEINE CATCH DATA SUMMARY FOR CRUISE 4B

Transect 4	Station O			Stat ion 1			Station 2			Station 3			Transact Summary		
Common Species Naae	Freq	Mean Abund	Nean Height	Freq	Nean Abund	Naan Weight	Freq	Nean Abund	Nean Weight	Freq	Wean Abund	Mean Weight	Freq	Nean Abund	Naan Weight
empty haul	0.0	0,0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ARCTIC LAMPREY	0.0	0,0	0.0	0.0	000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PACIFIC HERRING	0.0	0,0	0.0	0.0	0.0	0,0	0.0	0.0	0.0	0.0	0.0	0.0	040	0.0	0.0
PINK SALMON Juv	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	5.0	1.0	0.3	1.3
PINK SALMON Adult	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0,0	0.0	0.0	0.0	0.0	0,0	0.0	0.0
CHUM SALMON Juv	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	000
CHUN SALMON Adult	0.0	0.0	0.0	0.0	0.0	0.0	0,0	0.0	0.0	4.0	5.7	9847.8	1.0	1.4	2462.0
COHO SALMON Juv	0.0	0.0	0.0	0.0	0.0	0.0	2.0	1.3	72.4	3*0	7.3	547.4	2.0	2.2	1s5.0
SOCKEYE SALMON Juv	0.0	0.0	0.0	1.0	63.0	864.2	2.0	1.8	15.8	2.0	6.4	58.0	3.0	17.8	234.5
SOCKEYE SALNON Adult	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	199106	1.0	0.3	497.9
CHINOOK SALNON Juv	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
DOLLY VARDEN Juv	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0
DOLLY VARDEN Adult	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1316.1	0.0	0.0	0.0	0.0	0.3	329.0
SMELT UNID	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CAPELIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	000	0.0	0.0	0.0	0,0	0.0
RAINBOW WELT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0*0	0.0	0.0
PACIFIC COD	1.0	8.0	0.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	2.0	0.2
HALLEYE POLLOCK	1.0	13.0	3.s	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	3.3	0.9
THREESPINE STICKLEBACK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0,0	0.0	0.0
GREENLING UNID	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
WHITESPOTTED GREENLING	0.0	0.0	0.0	2.0	S.3	4.8	2.0	6.6	7.5	1.0	1.0	0.9	3.0	3 . 2	3.3
STAGHORN SCULPIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	316.7	1.0	0.3	79.2
GREAT SCULPIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
STURGEON POACHER	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0,0	0.0	0.0
PACIFIC SANDFISH	1.0	1.0	0.9	0.0	0.0	0.0	1.0	35.0	%s.1	1.0	1.0	133.4	3.0	9.3	274.9
PACIFIC SAND LANCE	0.0	0.0	0.0	1.0	1s.0	21.5.0	1.0	117.0	6s8 .0	1.0	1.0	1.7	3.0	33.3	218.7
YELLOWFIN SOLE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	48,3	1.0	0.3	12.1
STARRY FLOUNDER	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0,0	0.0	0.0	0.0
Number of Species	3.0			3.0			600			10.0			13.0		
Wean Abundance		22.0			83.3			162,7			26.4			73.6	
Mean Weight (gms)			5.3			1084.0			3034.9			12950.8			4268.8
Number of Sets			1.0			2.0			3.0			4.0			10.0

APPENDIX TABLE G-2

PURSE SEINE CATCH DATA SUMMARY FOR CRUISE 4B

Transect 6	Station 0			Station 1			Station 2			Stat ion 3		
Common Species Naaa	Freq	Nean bu	Naan Weight	Freq	Nean Abund	Mean Height	Freq	Naan Abund	Naan Height	Freq	Mean Abund	Naan Weight
eapty haul	1.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ARCTIC LAMPREY	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PACIFIC HERRING	0,0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PINK SALMON Juv	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PINK SALNON Adult	0.0	0.0	0.0	1.0	1.0	1133.6	0.0	0.0	0.0	0.0	0.0	0.0
CHUM SALMON Juv	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	3.0	5.0
CHUM SALNON Adult	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	6.0	21170.9
COHO SALMON Juv	0.0	0.0	0.0	0.0	0.0	0.0	2.0	0.9	32.0	1.0	2.0	112.5
SOCKEYE SAWN Juv	1.0	1.0	6.7	0.0	0.0	0.0	1.0	24.0	614.2	0.0	0.0	0.0
SOCKEYE SALMON Adult	0.0	0.0	0.0	1.0	1.0	1s92.0	0.0	0.0	0.0	0.0	0.0	0.0
CHINOOK SALNON Juv	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
DOLLY VARDEN Juv	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
DOLLY VARDEN Adult	0.0	0.0	0.0	0.0	0.0	0,0	0.0	0.0	0.0	0.0	0.0	0.0
WELT UNID	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CAPELIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
RAINSON MELT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PACIFIC COD	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HALLEYE POLLOCK	0.0	0.0	0.0	0.0	0.0	0.0	0,0	0.0	0.0	0.0	0.0	0.0
THREESPINE STICKLEBACK	0.0	0.0	0.0	100	2.0	5.8	1.0	2.0	4.4	1.0	6.0	18.3
GREENLING UNID	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
WHITESPOTTED GREENLING	1.0	1.0	1.7	1.0	4,0	6.7	1.0	9.0	8.8	1.0	7.0	7.5
STAGHORN SCULPIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
GREAT SCULPIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
STURGEON POACHER	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PACIFIC SANDFISH	0.0	0.0	0.0	0.0	0.0	0.0	1.0	4.0	530.8	1.0	5.0	14S8.6
PACIFIC SAND LANCE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
YELLOWFIN SOLE	0.0	0.0	0.0	0.0	0,0	0.0	0,0	0.0	0.0	0.0	0.0	0.0
STARRY FLOUNDER	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Number of Species	2.0			4.0			5.0			6.0		
Mean Abundance		2.0			8.0			39.9			29.0	
Naan Height (gms)			8.4			3038.1			1190.2			22772.8
Number of Sets			2.0			2.0			2.0			2.0

APPENDIX H

SMALL SEINE CATCH DATA 1985

APPENDIX TABLE H-1

SMALL SEINE CATCH DATA SUMMARY FOR CRUISE 4A

Transect 2	Station 3			Station 4			Transect Summary		
Common Species Name	Freq	Mean Abund	Mean Weight	Freq	Nean Abund	Nean Weight	Freq	mean Abund	Nean Weight
empty haul	1.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0
ARCTIC LAMPREY	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PACIFIC HERRING	0.0	0,0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PINK SALNON Juv	0.0	0,0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CHUN SALNON Juv	0.0	0,0	0.0	0.0	0.0	0.O	0.0	0.0	0.0
COHO SALMON Juv	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SOCKEYE SALNON Juv	2.0	36.0	179.8	2.0	1.9	8.9	2.0	19.0	94.4
CHINOOK SALNON Juv	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CAPELIN	1.0	0.7	14.5	1.0	0.8	12.3	2,0	0.8	13.4
RAINBOW WELT	0.0	0.0	0.0	0.0	0.0	0.O	0.0	0.0	0.0 ,
THREESPINE STICKLEBACK	0.0	0,0	0.0	0.0	0.0	0.O	0.0	0.0	0.0
WHITESPOTTED GREENLING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
STAGHORN SCULPIN	0.0	0.0	0,0	0.0	0.0	0.0	0.0	0.0	0.O
PACIFIC SANDFISH	0.0	0.0	0.0	0.0	0.0	0,0	0.0	0.0	0.0
SNAKE PRICKLESACK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PACIFIC SAND LANCE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Number of Species	2.0			2.0			2.0		
Mean Abundance		36.7			2.7			19.7	
Nean Weight (gas)			194.3			21.2			107.8
Number of Sets			3.0			2.0			5.0

APPENDIX TABLE H-1

SMALL SEINE CATCH DATA SUMMARY FOR CRUISE 4A

Transect 4	Station 3			Station 4			Station 7			Station 12			Station 13			Transect Summary		
Common Species Name	Freq	Mean Abund	Mean Weight	Freq	Mean Abund	Mean Weight	Freq	Haan Abund	Mean Weight	Freq	Uaan Abund	Mean Weight	Freq	Mean Abund	Mean Weight	Freq	Mean Abund	Mean Weight
aspty haul	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0,0	0.0	0.0	0.0	2.0	0.0	0.0
ARCTIC LAMPREY	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.O	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PACIFIC HERRING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0,0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PINK SALMON Juv	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0,0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CHUM SALMON Juv	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	2.4	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.2	0.5
COHO W Juv	1.0	1.7	62.5	2.0	7.0	330.0	2.0	1.0	46,3	0.0	0.0	0.0	0.0	0.0	0.0	3.0	1.9	87.8
SOCKEYE SALMON Juv	2.0	6.1	89.0	2.0	11.1	135.7	3.0	3S.2	351.9	0.0	0.0	0.0	l.0	295.7	236S.4	4.0	69.6	580.4
CHINOOK SALMON Juv	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CAPELIN	1.0	0.8	8.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.2	1.7
RAINBOW SMELT	0$0	0.0	0.0	0.0	0.0	0.0	1.0	9.3	309.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.9	77.8
THREESPINE STICKLEBACK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
WHITESPOTTED GREENLING	0.0	0.0	0.0	0$0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
STAGHORN SCULPIN	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.8	201,6	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.2	40.3
PACIFIC SANDFISH	0.0	0,0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SNAKE PRICKLEBACK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PACIFIC SAND LANCE	1.0	0.8	2.5	0.0	0.0	0.0	1.0	11.1	23.2	0.0	0.0	0.0	0.0	0,0	0.0	2.0	2.4	5.1
Number of Species	4.0			2.0			6.0			0.0			1.0			7.0		
Mean Abundance		9.4			18.1			58.4			0.0			295.7			76.3	
Mean Weight (gms)			162.3			465.7			1014.4			0,0			2365.4			801.6
Number of Sets			2.0			2.0			3.0			1.0			1.0			9.0

APPENDIX TABLE H-2

SMALL SEINE CATCH DATA SUMMARY FOR CRUISE 46

Transact 0	Station 8			Station 9			Station 10			Transect Summary		
Common Species Name	Freq	Nean Abund	Mean Weight	Freq	Nean Abund	Naan Weight	Freq	Mean Abund	Mean Weight	Freq	Mean Abund	Nean Weight
empty haul	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ARCTIC LAMPREY	1.0	0.9	9.3	1.0	0.9	9.3	0.0	0.0	0.0	2.0	0.6	6.2
PACIFIC HERRING	1.0	0.9	S.6	1.0	0.9	13.9	0.0	0.0	0.0	2.0	0.6	6.5
PINK SALMON Juv	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CHUM SALMON Juv	1.0	1.9	5.6	1.0	7.4	15.7	1.0	10.2	37.0	3.0	6.5	19.4
COHO SALNON Juv	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SOCKEYE SALNON Juv	1.0	0.9	4.6	1.0	1.9	13.9	1.0	1.9	13.9	3.0	1.6	10.8
CHINOOK SALMON Juv	1.0	0.9	3.7	1.0	0.9	13.9	0.0	0.0	0.0	2.0	0.6	5.9
CAPELIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
RAINEON MELT	1.0	10S.6	833.5	1.0	276.0	2S93.1	1.0	236.2	2s00.5	3.0	205.9	1975.7
THREESPINE STICKLEBACK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
WHITESPOTTED GREENLING	1.0	0.9	3.7	1.0	0.9	2.8	0.0	0.0	0.0	2.0	0.6	2.2
STAGHORN SCULPIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PACIFIC SANDFISH	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SNAKE PRICKLEBACK	0.0	0.0	0.0	1.0	0.9	9.3	0.0	0.0	0.0	1.0	0.3	3.1
PACIFIC SAND LANCE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Number of Species	7.0			8.0			3.0			8.0		
Nean Abundance		112.0			289.8			248.3			216.7	
Nean Weight (gms)			866.0			2671.9			25S1.4			2029.8
Number of Sets			1.0			1.0			1.0			3.0

APPENDIX TABLE H-2

SMALL SEINE CATCH DATA SUMMARY FOR CRUISE 4B

Transect 2		Station 4			Transect Summary	
Common Species Name	Freq	Nean Abund	Nean Height	Freq	Nean Abund	Nean Weight
empty haul	0.0	0,0	0.0	0.0	0,0	0.0
ARCTIC LAMPREY	0.0	0.0	0.0	0.0	0.0	0.0
PACIFIC HERRING	0.0	0.0	0.0	0.0	0.0	0.0
PINK SALNON Juv	0.0	0.0	0.0	0.0	0.0	0,0
CHUM SALNON Juv	1.0	16.7	37.0	1.0	16,7	37.0
COHO SALNON Juv	0.0	0.0	0.0	0.0	0.0	0.0
SOCKEYE SALMON Juv	0.0	0.0	0,0	0.0	0.0	0.0
CHINOOK SALMON Juv	0.0	0.0	0.0	0.0	0.0	0.0
CAPELIN	0.0	0.0	0.0	0.0	0.0	0.0
RAINBOW SMELT	0.0	0.O	0.0	0.0	0.0	0.0
THREESPINE STICKLEBACK	0.0	0.0	0.0	0.0	0.0	0.0
WHITESPOTTED GREENLING	0.0	0.0	0.0	0.0	0.0	0.0
STAGHORN SCULPIN	0.0	0.0	0.0	0.0	0.0	0.0
PACIFIC SANDFISH	0.0	0.0	0.0	0.0	0,0	0.0
SNAKE PRICKLEBACK	0.0	0.0	0.0	0.0	0,0	0.0
PACIFIC SAND LANCE	0.0	0.0	0.0	0.0	0.0	0.O
Number of Species	1.0			1.0		
Mean Abundance		16.7			16.7	
Mean Weight (gms)			37.0			37.0
Number of Sets			1.0			1.0

APPENDIX TABLE H-2

SMALL SEINE CATCH DATA SUMMARY FOR CRUISE 4B

Transect 4	Station 4			Station 7			Stat ion 12			Station 13			Transact Summary		
Common Species Name	Freq	Naan Abund	Nean Weight	Freq	Me Abund	Mean Weight	Fraq	Nean Abund	Mean Weight	Freq	Mean Abund	Nean Height	Freq	Naan Abund	Mean Weight
empty haul	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ARCTIC LAMPREY	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PACIFIC HERRING	0.0	0.0	0.0	2.0	6.0	105.6	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.5	26.4
PINK SALNON Juv	3.0	8.0	40.2	3.0	3.4	9.2	2.0	27.9	208.5	1.0	12.3	70.2	4.0	12.9	84.0
CHUM SALNON Juv	4.0	88.1	503.1	4.0	25.5	144.6	2.0	51.7	294.4	3.0	26.3	191.4	4.0	47.9	283.4
COHO SALNON Juv	2.0	4.4	313.2	1.0	2.4	134.9	2.0	1.3	39. s	0.0	0.0	0.0	3.0	2.0	121.9
SOCKEYE SALNON Juv	3.0	2.7	17.6	2.0	4.7	26.8	1.0	0.9	8.8	2.0	23.3	251.9	4.0	7.9	76.3
CHIN(KK SALNON Juv	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CAPELIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
RAINBOW WELT	1.0	0.9	10.5	1.0	20.4	833.5	0.0	0.0	0.0	0.0	0.0	0.0	2.0	5.3	213.0
THREESPINE STICKLEBACK	1.0	0.9	4.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.2	1.2
WHITESPOTTED GREENLING	2.0	0.9	1.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.2	0.5
STAGHORN SCULPIN	0.0	0.0	0.0	1.0	0.9	222.3	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.2	55.6
PACIFIC SANDFISH	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SNAKE PRICKLEBACK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PACIFIC SANO LANCE	0.0	0.0	0.0	0.0	0.0	0.0	1.0	282.5	2825.1	1.0	0.7	7.2	2.0	70.8	708.1
Number of Species	7.0			7.0			So			4.0			10.0		
Mean Abundance		105.9			63.3			364.3			62.6			149.0	
Nean Height (gas)			907.1			1476.9			3376.3			520.7			1570.3
Number of Sets			4.0			4.0			2.0			3.0			13.0

APPENDIX TABLE H-2

SHALL SEINE CATCH DATA SUMMARY FOR CRUISE 4B

Transect 6	Station 10			Station 11			Transect Summary		
Common Species Name	Freq	Nean Abund	Nean Height	Freq	Mean Abund	Mean Height	Freq	Nean Abund	Nean Weight
empty haul	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ARCTIC LAMPREY	0.0	0.0	0,0	0.0	0.0	0.0	0,0	0.0	0.0
PACIFIC HERRING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PINK SALMON Juv	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CHUM SALNON Juv	2.0	1.0	8.1	1.0	11.4	79.0	2.0	6.2	43.6
COHO SALNON Juv	2.0	2.1	68.0	1.0	4.4	280,8	2.0	3.3	174.4
SOCKEYE SALNON Juv	1.0	12.3	184.2	1.0	7.9	87.7	2.0	10.1	136,0
CHINOOK SALNON Juv	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CAPELIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
RAINBOW WELT	O.O	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
THREESPINE STICKLEBACK	1.0	0.9	2.6	0.0	0.0	0.0	1.0	0.5	1.3
WHITESPOTTED GREENLING	0.0	0.0	0.0	0.0	0.0	0,0	0.0	0.0	0.0
STAGHORN SCULPIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PACIFIC SANDFISH	1.0	0.9	17.5	0.0	0,0	0.0	1.0	0.5	8.8
SNAKE PRICKLEBACK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PACIFIC SANO LANCE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Number of Species	5.0			3.0			5.0		
Mean Abundance		17.2			23.7			20.5	
Hean Height (gins)			280.4			447. s			364.0
Number of Sets			2.0			1.0			3.0

APPENDIX I

BEACH SEINE CATCH DATA 1985

APPENDIX TABLE I-1

BEACH SEINE CATCH DATA SUNNARY FOR CRUISE 4A

Transect 4	Station 5			Station 6			Station 8			Station 9			Transect Summary		
Common Species Name	Freq	Nean Abund	Nean Height	Freq	Me Abund	Nean Weight	Freq	Nean Abund	Nean Height	Freq	Mean Abund	Mean Weight	Freq	Nean Abund	Nean Height
eapt y haul	0.0	0.0	0.0	2.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0
PACIFIC HERRING	1.0	1.0	180.0	0.0	0.0	0.0	0.0	0.0	0.0	0,0	0.0	0.0	1.0	0,3	45.0
PINK SALNON Juv	3.0	4.0	4.3	2.0	74.5	68.5	l.O	636.0	641.0	1.0	2.0	3.0	4.0	179.1	179.2
CHUM SALNON Juv	2.0	26.5	80.0	2.0	56.5	74,0	1.0	3257.0	3284.0	100	34.0	40.0	4.0	843.5	869.5
CHUM SALMON Adult	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.O	0.0	0.0	0.0	0.0	0.0	0.0	0.0
COHO SALMON Juv	3.0	14.3	390.0	1.0	1.0	40,0	0.0	0.0	0.0	1.0	3.0	60.0	3.0	4.6	122.5
SOCKEYE SALMON Juv	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.O	0.0	0.0	0.0	0.0	0.0	0.0
CHINOOK SALMON Juv	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.O	0.0	0.0	0.0	0.0	0.0	0.0	0.0
DOLLY VARDEN Adult	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0,0	0.0	0.0
POND SMELT	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	20.0	0.0	0.O	0.0	1.0	0.3	5.0
RAINBOW SMELT	3.0	35.7	426.7	1.0	1.0	12.0	0.0	0.0	0.0	1.0	8.0	25S.0	3,0	11.2	173.4
COD UNID	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.O	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PACIFIC COD	1.0	100	5.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.3	1.3
MALLEYE POLLOCK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
THREESPINE STICKLEBACK	0,0	0.0	0.0	0.0	0.0	0.0	0.0	0*0	0.0	0.0	0.0	0.0	0.0	0,0	0.0
NINESPINE STICKLEBACK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
WHITESPOTTED GREENLING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0,0	0,0	0.0
SCULPIN UNID	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	10.0	1.0	0.3	2.5
THREADED SCULPIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	10.0	1.0	0.3	2.s
STAGHORN SCULPIN	1.0	1.0	570.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.3	142.5
GREAT SCULPIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
STURGEON POACHER	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TUBENOSE POACHER	3.0	1,3	5.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	003	1.3
SNAKE PRICKLEBACK	0.0	0.0	0.0	0.0	0.O	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SADDLEBACK GUNNEL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PACIFIC SAND LANCE	l.O	1.0	l.O	2.0	671.0	1280.0	1.0	253.0	884.0	0.0	0.0	0.0	3.0	231.3	541,3
ROCK SOLE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
YELLOWFIN SOLE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ARCTIC FLOUNDER	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
STARRY FLOUNDER	0.0	0.0	0.0	1.0	1.0	100.0	0.0	0.0	0.0	0.0	0.0	0s0	1.0	0.3	25.0
ALASKA PLAICE	0.0	0.0	0.0	1.0	1.0	1.0	0.0	0.0	0.0	1.0	1.0	3s.0	2.0	0.5	9.0
Number of Species	9.0			7.0			4.0			7.0			14.0		
Naan Abundance		85.8			806.0			4147.0			50.0			1272.2	
Nean Weight (gas)			1662.3			1s75.5			4829,0			413.0			2120.0
Number of Sets			3.0			5.0			1.0			1.0			10.0

APPENDIX TABLE I-2

BEACH SEINE CATCH DATA SUMMARY FOR CRUISE 4B

Transect O	Station 4			Station 5			Station 7			Transect Summary		
Common Species Name	Freq	Mean Abund	Mean Height	Freq	Mean Abund	Mean Height	Freq	Mean Abund	Mean Height	Freq	Mean Abund	Mea Height
empty haul	0.0	0.0	0,0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PACIFIC HERRING	0.0	0.0	0,0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PINK SALNON Juv	0.0	0.0	0.0	0.0	0.0	0.0	0,0	0.0	0.0	0.0	0.0	0.0
CHUM SALMON Juv	0.0	0.0	0.0	1.0	7.0	4,0	0.0	0.0	0.0	1.0	2.3	1.3
CHUM SALMON Adu 1 t	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
COHO SALMON Juv	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0,0	0.0	0.0
SOCKEYE SALMON Juv	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CHINOOK SALMON Juv	0.0	0.0	0.0	1.0	1.0	2.0	0.0	0.0	0.0	1.0	0.3	0.7
DOLLY VARDEN Adult	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
POND SMELT	2.0	24.5	112.s	3.0	14.0	51.7	0.0	0.0	0,0	2.0	12.8	54.7
RAINBOW MELT	2.0	95.5	1%2.5	3.0	9.7	233.3	2.0	131.5	1350.0	3.0	78.9	1181.9
COD UNID	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PACIFIC COD	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
WALLEYE POLL(XX	0.0	0.0	0.0	2.0	1.0	9.0	0.0	0.0	0.0	1.0	0.3	3.0
THREESPINE STICKLEBACK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NINESPINE STICKLEBACK	0.0	0,0	0.0	1.0	1.0	5.0	1.0	1.0	1.0	2.0	0.7	2.0
WHITESPOTTED GREENLING	0,0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SCULPIN UNID	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
THREADED SCULPIN	0.0	0.0	0.0	0.0	0.0	0.0	0,0	0.0	0.0	0.0	0.0	0.0
STAGHORN SCULPIN	1.0	2.0	360.0	1.0	1.0	310.0	2.0	4.0	67.S	3.0	2.3	245.8
GREAT SCULPIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
STURGEON POACHER	2.0	1.5	14.0	0.0	0,0	0.0	0.0	0.O	0.0	1.0	0.5	4.7
TUBENOSE POACHER	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SNAKE PRICKLEBACK	2.0	13.5	220.0	1.0	8.0	2S0.0	2.0	20,0	105.0	3.0	13.8	191.7
SADDLEBACK GUNNEL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PACIFIC SAND LANCE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ROCK SOLE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
YELLOWFIN SOLE	1.0	1.0	10.0	1.0	1.0	8.0	1.0	1.0	3.0	3.0	1.0	7.0
ARCTIC FLOUNDER	0.0	0.0	0.0	1.0	1.0	9.0	0.0	0.0	0.0	1.0	0.3	3.0
STARRY FLOUNDER	2.0	25. S	305.0	3.0	100.3	1643.3	2.0	46,0	305.0	3.0	57.3	777.8
ALASKA PLAICE	1.0	2.0	2.0	2.0	2.s	4.0	0.0	0.0	0.0	2.0	1.5	2.0
Number of Species	8.0			12.0			6.0			13.0		
Nean Abundance		165.5			147.5			203.5			172.2	
Hean Weight (gas)			3066.0			2529.3			1831. S			2475.6
Number of Sets			2.0			3.0			2.0			7.0

APPENDIX TABLE I-2

BEACH SEINE CATCH DATA SUMMARY FOR CRUISE 4B

Transect 2	Station 5			Station 6			Transect Summary		
Common Species Name	Freq	Naan Abund	Mean Height	Freq	Mean Abund	Mean Weight	Freq	Mean Abund	Mean Weight
empty haul	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PACIFIC HERRING	1.0	1.0	30.0	0.0	0.0	0.0	1.0	0.s	1s.0
PINK SALMON Juv	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0,0
CHUM SALMON Juv	2.0	3.0	3.0	0.0	0.0	0.0	1.0	1.s	1.5
CHUM SALNON Adult	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0,0
COHO SALMON Juv	2.0	1.5	10.0	0.0	0.0	0.0	1.0	0.8	5.0
KICKEYE SALNON Juv	1.0	1.0	20.0	0.0	0.0	0.0	1.0	0.5	10.0
CHINOOK SALMON Juv	1.0	1.0	8.0	0.0	0.0	0.0	1.0	0.s	4.0
DOLLY VARDEN Adult	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
POND SMELT	1.0	1.0	5.0	1.0	1.0	8.0	2.0	1.0	6.5
RAINBOW SMELT	3.0	204.7	5000.0	3.0	267.7	4740.0	2.0	236.2	4870.0
COO UNID	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PACIFIC COD	0.0	0.0	0.0	1.0	1.0	1s.0	1.0	0.5	7.s
WALLEYE POLL(M	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0,0	0.0
THREESPINE STICKLEBACK	1.0	1.0	3.0	0.0	0.0	0.0	1.0	0.5	1.5
NINESPINE STICKLEBACK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0,0	0.0
WHITESPOTTED GREENLING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SCULPIN ONID	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
THREADED SCULPIN	0.0	0,0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
STAGHORN SCULPIN	2.0	3.0	11s.0	3.0	3.3	50s.0	2.0	3.2	310.0
GREAT SCULPIN	0.0	0.0	0.0	0,0	0.0	0.0	0.0	0.0	0.0
STURGEON POACHER	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TUBENOSE POACHER	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SNAKE PRICKLEBACK	1.0	1.0	20.0	1.0	1.0	40,0	2.0	1.0	30.0
SADDLEBACK GUNNEL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PACIFIC SAND LANCE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ROCK SOLI!	1.0	10.0	900.0	0.0	0.0	0.0	1.0	5.0	450.0
YELLOWN SOLE	2.0	2.s	150.0	1.0	5.0	300.0	2.0	3.8	225,0
ARCTIC FLOUNDER	2.0	3.s	125.0	2.0	42.5	1s50.0	2.0	23.0	837.S
STARRY FLOUNDER	3.0	26.0	1S80.0	3.0	26.3	490,0	2.0	26,2	118S.0
ALASKA PLAICE	3.0	5.3	376.7	1.0	5.0	30.0	2.0	S.2	203.4
Number of Species	1s.0			9.0			16.0		
Nean Abundance		265.S			3S2.8			309.2	
Nean Weight(gms)			0645.7			7678.0			8161.9
Number of Sets			3.0			3.0			6.0

APPENDIX TABLE I-2

BEACH SEINE CATCH DATA SUMMARY FOR CRUISE 4B

Transect 4	Station 5			Station 6			Station 8			Station 9			Transect Summary		
Common Species Name	Freq	Nean Abund	Mean Height	Freq	Mean Abund	Naan Height	Freq	Naan Abund	Mean Height	Freq	Nean Abund	Nean Height	Freq	Nean Abund	Naan Height
empty haul	0.0	0.0	0.0	0,0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PACIFIC HERRING	0.0	0.0	0.0	1.0	11.0	150.0	0.0	0.0	0.0	0,0	0.0	0.0	1.0	2.8	37.5
PINK SALNON Juv	3.0	10.0	11.0	2.0	1.5	2.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0	2.9	3.3
CHUM SALNON Juv	4,0	66.0	205.0	3.0	9.0	19.7	1.0	3.0	10.0	2.0	4.0	21,0	4.0	20.5	63.9
CHUN SALNON Adult	0.0	0.0	0.0	0.0	0.0	0.0	2.0	1.0	1874.0	0.0	0.0	0.0	1.0	0.3	46S. s
COHO SALNON Juv	0.0	0.0	0.0	2.0	2.0	29.5	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.5	7.4
SOCKEYE SAMON Juv	0.0	0.0	0.0	1.0	3.0	4.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.8	1.0
CHINOOK SALMON Juv	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
DOLLY VARDEN Adult	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0
POND SMELT	1.0	1.0	1s.0	0.0	0.0	0.0	0.0	0.0	0,0	1.0	1.0	50.0	2.0	0.5	16.3
RAINBOW SMELT	2.0	4.0	57.5	2.0	4.5	%.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0	2.1	30.4
COD UNID	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0
PACIFIC COD	0>0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HALLEYE POLLOCK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
THREE-SPINE STICKLEBACK	1.0	1.0	2.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.3	0.5
NINESPINE STICKLEBACK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
WHITESPOTTED GREENLING	1.0	1.0	2.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0	0.3	0.5
SCULPIN UNID	0,0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
THREADED SCULPIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
STAGHORN SCULPIN	2.0	1.5	197.5	2*0	2.5	151.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0	1,0	87.1
GREAT SCULPIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
STURGEON POACHER	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	000
TUBENOSE POACHER	1.0	2.0	5.0	2.0	3.5	45.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0	1.4	12.5
SNAKE PRICKLEBACK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SADDLEBACK GUNNEL	1.0	1.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.3	0.3
PACIFIC SAND LANCE	2.0	92.0	194.0	5.0	233.2	2432.4	2.0	227.0	2520.0	2.0	352.0	1628.0	4.0	226.1	1693.6
ROCK SOLE	040	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
YELLOWFIN SOLE	2.0	1.0	33*5	0.0	0.0	0.0	1.0	1.0	Boo	0.0	0.0	0.0	2.0	0.5	28.4
ARCTIC FLOUNDER	0.0	0.0	0.0	1.0	1.0	2.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.3	0.5
STARRY FLOUNDER	0,0	0.0	0.0	1.0	1.0	1.0	0.0	0.0	0.0	1.0	1.0	65000	2.0	0.5	162.8
ALASKA PLAICE	0.0	0.0	0.0	2.0	5.0	13.0	0.0	0.0	0.0	0.0	0.0	0,0	1.0	1.3	3.3
Number of Species	11.0			12.0			4.0			4.0			20.0		
Mean Abundance		180.5			277.2			232.0			358.0			229.9	
Mean Height (gms)			723.5			2945.6			4404.0			2349.0			2717.7
Number of Sets			5.0			5.0			2.0			2.0			14.0

APPENDIX TABLE I-2

BEACH SEINE CATCH DATA SUNNARY FOR CRUISE 4B

Transect 6	Station 6			Station 7			Transact Summary		
Common Species Name	Freq	Mean Abund	Mean Height	Freq	Mean Abund	Mean Height	Freq	Mean Abund	Mean Height
empty haul	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PACIFIC HERRING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PINK SALMON Juv	0.0	0.0	0,0	0,0	0.0	0.0	0.0	0.0	0.0
CHUM SALMON Juv	2,0	13,0	75.0	2.0	73.0	415.0	2.0	43.0	24S.0
CHUM SALNON Adult	0.0	0.0	0.0	0.0	0.0	0.0	0,0	0.0	0,0
COHO SALMON Juv	0.0	0.0	0.0	2.0	3.S	12. s	1.0	1.8	6.3
SOCKEYE SALMON Juv	0.0	0.0	0.0	1.0	1.0	4.0	1.0	0.5	2.0
CHINOOK SALMON Juv	0,0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0,0
DOLLY VARDEN Adult	1.0	1.0	450.0	0.0	0.0	0.0	1.0	0.5	22s.0
FOND SMELT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0,0	0.0
RAINBOW SMELT	0.0	0.0	0.0	0.0	0.0	0.0	0,0	0,0	0.0
COD UNID	1.0	2,0	3.0	0.0	0.0	0.0	1.0	1.0	1.5
PACIFIC COD	0.0	0,0	0.0	0,0	0.0	0.0	0.0	0.0	0.0
HALLEYE POLLOCK	0.0	0.0	0.0	0.0	0.0	0.0	0,0	0.0	0.0
THREESPINE STICKLEBACK	0,0	000	0.0	1.0	1.0	3.0	1.0	0.5	1.5
NINESPINE STICKLEBACK	0.0	0.0	0.0	0.0	0,0	0.0	0.0	0.0	0.0
WHITESPOTTED GREENLING	1.0	1.0	5.0	0,0	0.0	0.0	1.0	0.5	2.5
SCULPIN UNID	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
THREADED SCULPIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
STAGHORN SCULPIN	0.0	0.0	0.0	1.0	1.0	20.0	1.0	0.5	10.0
GREAT SCULPIN	2.0	3.0	320.0	1.0	3.0	60.0	2.0	3.0	190.0
STURGEON POACHER	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TUBENOSE POACHER	0.0	0,0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SNAKE PRICKLEBACK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SADDLEBACK GUNNEL	0.0	0.0	0.0	1.0	2.0	5.0	1.0	1.0	2.s
PACIFIC SAND LANCE	0.0	0.0	0.0	2.0	2102.0	2597,0	1.0	10s1.0	1290. s
ROCK SOLE	0.0	0.0	0.0	1.0	3.0	13.0	1.0	l.S	6.S
YELLOWFIN SOLE	0.0	0,0	0.0	1.0	4.0	140.0	1.0	2.0	70.0
ARCTIC FLOUNDER	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
STARRY FLOUNDER	2.0	1.0	57.0	2.0	1.0	101.0	2.0	1.0	79.0
ALASKA PLAICE	1.0	5.0	60.0	2.0	1.0	1.5	2.0	3.0	30.0
Number of Species	7.0			12.0			15.0		
Nean Abundance		26.0			2195.5			1110.8	
Nean Weight(gms)			970.0			3372.0			2171.0
Number of Sets			2.0			2.0			4.0

APPENDIX J

ADULT SALMON CATCH DATA 1962-1985

APPENDIX TABLE J-1. RETURNS (IN THOUSANDS) OF ADULT SALMON BY ADF&G COMMERCIAL FISHING DISTRICTS WITHIN THE NAS STUDY AREA. DATA ARE NOT AVAILABLE FOR ALL SPECIES.

	NORTHERN DISTRICT			NORTHWESTERN DISTRICT		
YEAR	SOCKEYE	CHUM	CHINOOK	SOCKEYE	CHUM	PINK
1962	541.1	54*5	9.7	S9.8	131.2	34.8
1963	515.1	52.8	9.5	60.9	200.3	10.4
1964	585.7	96.6	29.6	85.0	1'37.4	21.8
1965	408.9	43.'3	28.3	28.4	75.1	2.9
1966	495.0	112.2	11.4	36.2	120.1	17.7
1967	496.8	95.5	16.5	28.2	67.0	1.0
1968	457.1	112.9	19.s	33.5	211.5	26.5
1969	033.4	67.6	17.5	63.1	10'3.2	4.4
1970	618.7	137.6	9.9	45.8	76.2	18.9
1971	746.0	69.8	7.2	43.3	103.8	8.8
1972	352.9	72.3	6.6	16.8	136.4	1.2
1973	341.6	99.4	7.7	10.8	178.7	0.2
1974	548.8	40.4	8.0	15.6	96.3	33.3
1975	728.0	22.4	6.7	22.3	95.5	0.6
1976	1117.5	155.0	10.9	S6.2	212.0	37.3
1977	922.5	330.4	12.6	89.7	478.6	6.4
1978	2025.0	179.6	27.9	85.1	294.3	558.2
1979	3436.6	150.4	32.8	116.6	220.7	10.9
1980	2633.7	697.9	27.8	151.0	772.8	391.9
1981	3068.5	627.7	30.7	123.7	620.1	14.8
1982	2066.9	503.5	50.1	84.6	285.4	56.8
1983	2611.5	378.2	55.2	62.2	363.2	5.2
1984	2268.7	1023.6	40.6	291.1	460.0	42.8
1985	3363.7	547.9	36.6	23.6	343.2	23.0